due to CFRP debonding. Therefore, it was recommended that the dimensions (i.e., length and width) and layout of the CFRP sheets be carefully considered to obtain the highest strengthening performance.

4. Conclusions

This research investigated the flexural behavior of one-way concrete slabs with openings reinforced with GFRP bars and strengthened using CFRP sheets through NLFE analysis. First, the results suggested that using proper concrete compressive strengths improved the performance of the slab, with better incorporation of CFRP sheets. In this study, the concrete compressive strengths ranging from 30 MPa to 35 MPa were more suitable with the sample's setup. Secondly, it can be observed that increasing the reinforcement ratio reduces ductility while increasing the ultimate strength of the slab sample. The GFRP bars also participated more in the case of a smaller reinforcement ratio. Finally, the disposition layout of CFRP sheets was considered, revealing its influence on the slab's stiffness and ductility. A disposition layout concentrated around the opening improved its performance. Theparametric investigations thus providedvaluable insights into optimizing the structural performance of the considered slabs./.

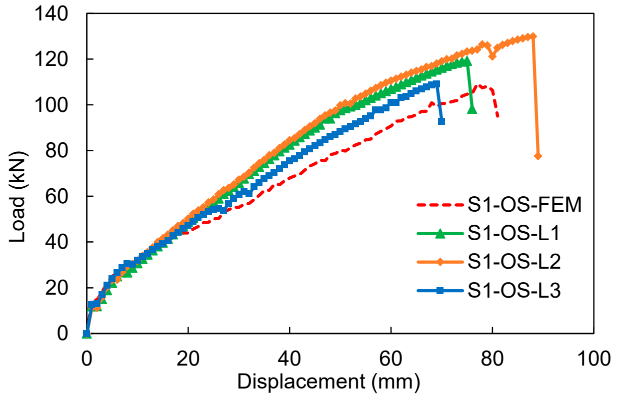

Figure 7. Load-displacement curves of CFRP-strengthened slabs with considered strengthening layouts

References

1. M. Z. Naser, R. A. Hawileh, and J. A. Abdalla. Fiber-reinforced polymer composites in strengthening reinforced concrete structures: A critical review Engineering Structures, vol. 198, 109542, 2019.
2. N. T. Nguyen, T. K. Nguyen, D. H. Du, D. N. Nguyen, and T. S. Kieu.Nonlinear finite element analysis of FRP-strengthened full-size reinforced concrete beams.Innovative Infrastructure Solutions, vol. 8, no. 5, p. 139, 2023.
3. Ö. Anil, N. Kaya, and O. Arslan. Strengthening of one-way RC slab with opening using CFRP strips.Construction and Building Materials, vol. 48, 883–893,2013.
4. H. M. Afefy and T. M. Fawzy. Strengthening of RC one-way slabs including cut-out using different techniques.Engineering Structures, vol. 57, 23–36,2013.
5. T. K. Nguyen, N. T. Nguyen, H. A. Tran, H. G. Nguyen, and P. Tran. Three-dimensional nonlinear finite element analysis of corroded reinforced concrete beams strengthened by CFRP sheets.European Journal of Environmental and Civil Engineering, 1–27, 2024.
6. H. D. Vu and D. N. Phan. A framework for predicting the debonding failure modes of RC beams strengthened flexurally with FRP sheets.Innovative Infrastructure Solutions, vol. 7, no. 5, 292, 2022.
7. M. A. Golham and A. H. A. Al-Ahmed. Strengthening of GFRP Reinforced Concrete Slabs with Openings.Journal of Engineering, vol. 30, no. 01, 157–172, 2024.
8. X. Z. Lu, J. G. Teng, L. P. Ye, and J. J. Jiang. Bond–slip models for FRP sheets/plates bonded to concrete.Engineering Structures, vol. 27, no. 6, 920–937, 2005.
9. A. A. Mansor, A. S. Mohammed, and W. D. Salman. Effect of longitudinal steel reinforcement ratio on deflection and ductility in reinforced concrete beams.IOP Conference Series: Materials Science and Engineering, vol. 888, no. 1, 012008, Jul. 2020.

Reflection, transmission of QP- wave at an imperfect interface...

(tiếp theo trang 37)

the reflection coefficients of waves in an imperfect interface are greater than the ones in slip interface while transmission coefficients are the opposite. For the case of slip interface, the valley value of the reflection coefficient of qP wave is attained at $\theta_0=24^o$; 24^o, while that one is attained at $\theta_0=68^o$; 72^o for imperfect interface.

6. Conclusion

In conclusion, a mathematical study of reflection and transmission coefficients at an imperfect interface separating two transversely isotropic nonlocal elastic solid half spaces is made when longitudinal wave is incident. The three cases of imperfect interfaces are discussed briefly. For the incidence qP wave, the expressions for reflection, transmission coeffi cients of waves in the imperfect/perfect cases are given. Numerical computations have been performed for a particular model and the results obtained are depicted graphically./.

References

1. Z. Hashin, The spherical inclusion with imperfect interface. J. Appl. Mech, vol. 58, no. 2, pp. 444–449, 1991.
2. S. I. Rokhlin and Y. J. Wang, Analysis of boundary conditions for elastic wave interaction with an inter face between two solids. J. Acoust. Soc. Am, vol. 89, no. 2, pp. 503–515, 1991.
3. J. D. Achenbach, Wave Propagation in Elastic Solids. vol. 16. Series in Applied Mechanics. North Holland: Amsterdam. 1973
4. A. H. Nayfeh, Wave Propagation in Layered Anisotropic Media, North-Holland: Amsterdam, 1995.
5. D. X. Tung, The reflection and transmission of waves at an imperfect interface between two nonlocal transversely isotropic liquid-saturated porous half spaces. Waves Random Complex Media, pp. 1–17, 2021.
6. S. Goyal, S. Sahu and S. Mondal, Influence of imperfect bonding on the reflection and transmission of QP-wave at the interface of two functionally graded piezoelectric materials. Wave Motion, vol. 92, pp. 102431, 2020.

Some safety issues in construction of climbing formwork system in high - rise building construction in Vietnam

Trinh Xuan Vinh[1], Tran Tien Huynh[2]

Abstract

The paper presents some safety issues in the construction of climbing formwork systems in high-rise building construction in Vietnam.

High-rise buildings impose stringent safety requirements on the implementation of climbing formwork systems. A specific safety plan must be in place, including identifying and eliminating potential hazards, providing adequate personal protective equipment, and ensuring compliance with industry safety regulations and standards.

Safety practices in Vietnam adhere to the national technical standard QCVN 18:2021/BXD on Safety in Construction and draw from international organizations such as OSHA (Occupational Safety and Health Administration of the United States), CEN (European Committee for Standardization), and Japan's guidelines on construction safety regulations. These references provide specific guidance and international standards for the construction of climbing formwork systems.

Key words: Safety; climbing formwork systems; high-rise building

Msc. Trinh Xuan Vinh
Ha Noi Architectural University
Email: trinhvinh2603@gmail.com,
Tel: 0904330488
Msc. Tran Tien Huynh
Ha Noi Architectural University
Email: trantienhuynhhau@gmail.com,
Tel: 0915666866

Date of receipt:
Editing date:
Post approval date: 03/11/2024

1. Introduction

In the construction industry, the implementation of Climbing formwork systems (CFS) for high-rise buildings requires specialized expertise and particular attention. With high-rise buildings often exceeding 20 floors, safety concerns become increasingly important and need to be carefully considered and addressed.

Figure 1. The Landmark81, Ho Chi Minh City. Source: https://www.coteccons.vn

2. Safety Requirement

High-rise buildings impose stringent safety requirements on the implementation of climbing formwork systems. A specific safety plan must be in place, including identifying and eliminating potential hazards, providing adequate personal protective equipment, and ensuring compliance with industry safety regulations and standards.

Safety practices in Vietnam adhere to the national technical standard QCVN 18:2021/BXD on Safety in Construction and draw from international organizations such as OSHA (Occupational Safety and Health Administration of the United States), CEN (European Committee for Standardization), and Japan's guidelines on construction safety regulations. These references provide specific guidance and international standards for the construction of climbing formwork systems.

In recent years, climbing formwork systems have been widely used in Vietnam due to their ability to meet project schedules, quality requirements, and especially high levels of occupational safety. Safety measures for climbing formwork systems require strict adherence throughout the installation and dismantling processes.

For installation work, the following requirements apply:

- Large formwork panels for multiple levels should only be installed after the formwork for lower levels has been securely fixed.

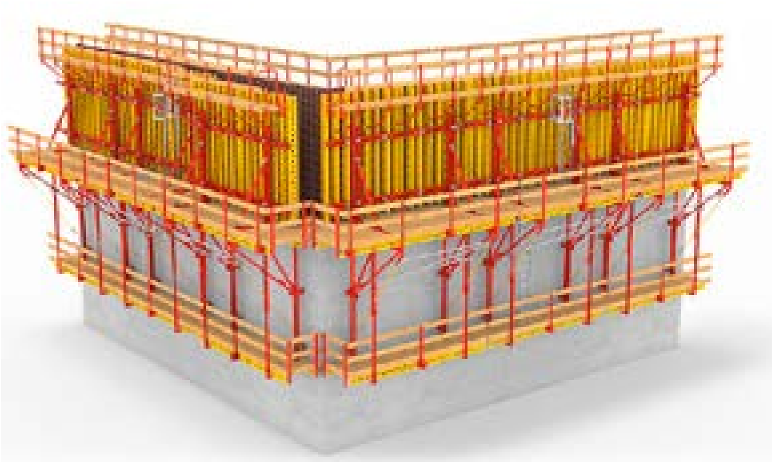

Figure 2. Climbing Formwork.Source: https://peri.com.vn

- To prevent the collapse of formwork during fabrication and installation, it is imperative to strictly follow the design and instructions provided by the site engineer.

- When working, workers must wear safety harnesses, and these harnesses must be securely fastened to sturdy components or structures.

- When installing formwork at a height of 1.5 meters or more above ground level or floor, workers must stand on a stable operating platform, be secured on scaffolding, a scaffold chair, or a high scaffold, have a protective railing at least 1 meter high, and two horizontal bars spaced 30cm apart.

- When installing column or beam formwork, or walls up to 5.5 meters high, mobile scaffolding can be used; if higher than 5.5 meters, high scaffolding should be used.

- When constructing formwork for reinforced concrete walls using climbing formwork, there must be a sturdy operating platform with a secure railing.

For dismantling work, several requirements need to be prepared, including:

- Manpower (workers, supervising engineers, safety officers).

- Tower crane, warning devices, construction equipment.

- Personal protective equipment, barriers, hazard zoning.

- Adequate storage space, within the lifting radius of the crane (ensuring the formwork has enough ground to "land").

- The crane's lifting ears are not damaged.

- The formwork operating platform is free from falling objects.

- Avoid leaving accessories (anchors, wedges, etc.), falling objects, or construction tools on the operating platform.

- At the same time, it is essential to check the conditions of the erection crane, weather conditions before dismantling.

3. Challenges:

The construction of climbing formwork systems for high-rise buildings faces numerous challenges. For buildings exceeding 20 floors, stability issues of the ground, harsh weather conditions, and other natural factors can pose significant risks to labor safety. Research from research organizations and the Vietnamese government also provides information on natural conditions and local factors that need to be considered during construction.

These include:

- Ensuring labor safety: working at heights requires strict compliance with labor safety regulations. Appropriate protective measures such as safety harnesses, automatic rescue equipment, and safety training for construction workers are necessary.

- Load-bearing capacity: Climbing formwork systems must withstand sufficient loads to resist the impact of construction loads and environmental factors such as wind, rain, etc.

- Stability: While working at heights allows for flexibility in the construction process, the stability of climbing formwork systems remains a significant concern. It is necessary to design and install a robust formwork support system to ensure worker safety.

- Maintenance and upkeep: After completing the work,

Figure 3. Climbing Formwork used at Landmark 81 project. Source: https://www.coteccons.vn

Figure 4. HSE System. Source: https://www.aedge.com.sg/hse

maintaining and servicing the climbing formwork system is also crucial. Regular inspections, maintenance, and repairs of the formwork components are necessary to ensure its safety and performance during use.

4. Solutions and Improvements:

To address these challenges, close collaboration among contractors, engineers, and project managers is necessary. Investment in advanced safety technologies and equipment, such as automated climbing formwork systems, safety monitoring devices, and quality control systems, can help minimize risks and enhance work efficiency. It is also essential to leverage research and construction experience from both domestic and international organizations to apply suitable solutions for specific conditions in Vietnam.

Utilizing Advanced Climbing Formwork Technology:

Investing in automated climbing formwork systems and modern construction technologies can help minimize labor risks and increase efficiency. Automated systems optimize the formwork process and reduce reliance on labor-intensive tasks.

Implementing Safety Monitoring Systems:

Using modern safety monitoring systems such as surveillance cameras, safety sensors, and automatic alarm systems to monitor and detect potential hazards. This helps alert employees and project managers promptly to take preventive measures.

Providing Professional Safety Training:

Ensure that all employees involved in the construction process receive training in occupational safety and the use of personal protective equipment. Regular and continuous training improves awareness and compliance with safety procedures.

Research and Application of International Experience:

Learn and apply safety methods and experiences from developed countries such as the United States, Europe, and Japan. Sharing knowledge and experiences from international projects helps enhance the capacity and effectiveness of the construction process.

Figure 5. RCS- P (Rail Climbing System Protection Panel) used at Landmark 81 project. Source: https://coffanhom.com

For the scope of this article, we refer to some experiences regarding occupational safety management in construction projects in Japan.

Establishing a Safety and Health Management System in the Construction Industry:

The prevention of industrial accidents is the responsibility of each construction employer that employs workers. However, as a large number of workers employed by different employers are working together at the same workplace, specific systems or programs for accident prevention are required in the construction industry to ensure the safety of all workers, including subcontractor workers, in addition to the responsibility of each employer.

Management system at a workplace where a master employer employs two or more subcontractors:

Figure 6. Safety Management Systems. Source: https://ehsdailyadvisor.blr.com

Types of undertakings and the number of workers for which an overall safety and health controller(Soukatsu-Anzen-Eisei-Sekininsha) must be appointed

- Undertakings involving tunnel construction, bridge construction (limited to construction on roads or sites close to roads, or on rails or sites close to rails, within areas of concentrated population) and work using compressed-air methods, in which more than 30 workers are regularly employed, including subcontractor workers.

- Other undertakings in which more than 50 workers are regularly employed, including subcontractor worker.

Employers who must appoint a safety and health supervisor(Anzen-Eisei-Sekininsha)

- All subcontractors must appoint a safety and health supervisor when they participate in a construction undertaking for which an overall safety and health controller (Soukatsu-Anzen-Eisei-Sekininsha) has been appointed.

Employers who must appoint a master safety and health supervisor (Motokata-Anzen-Eisei-Sekininsha)

- Master employers must appoint a master safety and health supervisor for work undertaken by said employer itself if an overall safety and health controller (Soukatsu-Anzen-Eisei-Sekininsha) has been appointed for the undertaking.

Employers who must appoint a safety supervisor, health supervisor and industrial physician

- Master employers and each subcontractor must appoint a safety supervisor, health supervisor and industrial physician when such master employer and subcontractor employ more than 50 workers at the workplace.

Employers who must appoint an operations-chief

- All employers must appoint an operations chief to any undertaking for which the appointment of an operations-chief (Sagyo-Shuninsha) is legally required.

Risk Management Optimization:

Implement comprehensive risk management, from assessing and identifying potential hazards to developing prevention and response plans. Diligent risk management helps minimize workplace accidents and incidents during construction.

Understand the risks

Begin by identifying hazards in your workplace. A hazard is anything that may cause harm, such as chemicals, electricity, or equipment.

After you determine what hazards exist in your workplace, the next step is to assess the risk these hazards pose to workers, so you can dedicate the appropriate

(xem tiếp trang 80)

Figure 7. Professional Safety Training. Source: https://imcinstitute.ae; https://mtvco.vn/

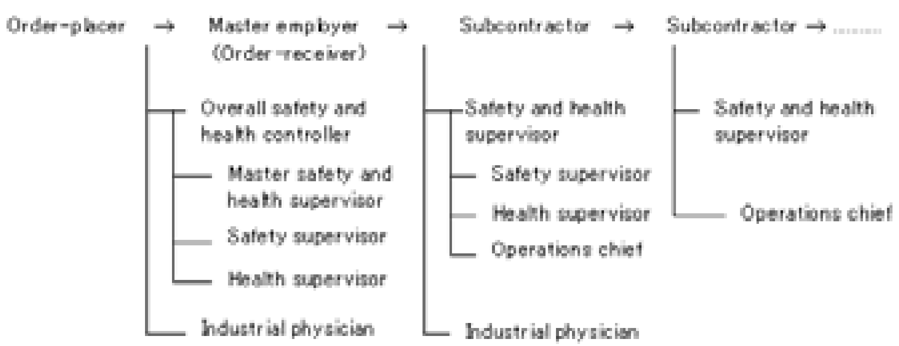

Figure 8. Safety and health management systems. Source:https://www.jisha.or.jp

Figure 9. Safety and health management systems. Source:https://www.jisha.or.jp

Evaluation of the ability of the random forest algorithm in machine learning for studying construction hydraulics

Nguyen Minh Ngoc[1], Bui Hai Phong[2]

Abstract

The Decision Tree and Random Forest algorithm is a "black box" prediction model, this algorithm is formed based on the "binary tree" structure. The study conducted an analysis of the structure of the Random Forest algorithm, built a process for analyzing and predicting a hydraulic factor using the regression algorithm. In particular, Pi theory is used to analyze and determine the objective function, thereby determining the input data fields for the Machine Learning model, coordinating experimental data with physical experimental model of the hydraulic jump in the trapezoidal channel. The study analyzed machine learning models according to Decision Tree and Random Forest algorithms, the research results showed good computational efficiency, strong correlation coefficient (R2 ≥ 0.9), other statistical indicators are very close to the ideal point (zero), the MAPE is from 3% to 6%. The study also shows that the Random Forest model has better prediction performance than the Decision Tree for the hydraulic factors of water jumping in an horizontal trapezoidal channel.

Key words: Machine Learning, Decision Tree, Random Forest, Pi theory, Hydraulic jump

[1] Department of Water technology, of Urban Environmental and Infrastructural Engineering, Hanoi Architectural University, Hanoi, Vietnam, Email:ngocnm@hau.edu.vn; Tel: 0396050595

[2] Department of Computer networks and information systems, Faculty of Information Technology, Hanoi Architectural University, Hanoi, Vietnam, Email: phongbh@hau.edu.vn; Tel: 0915594033

Date of receipt: 25/10/2024
Editing date: 26/11/2024
Post approval date: 04/11/2024

1. Introduction

Machine Learning (ML) is a powerful branch of artificial intelligence (AI) research that has been developed since the 1980s. Machine Learning is a field of Computer Science that has the ability to learn on its own based on input data without requiring specific programming algorithms for the research subject. Instead of writing programming lines for software manually with a specific set of instructions to complete a specific task, the machine is "trained" using large amounts of data and algorithms that allow it to learn how to perform tasks [1].

Machine learning has a very close relationship with statistical theory. Machine learning uses statistical models to "remember" the distribution of data, simulating the ability to generalize and infer, and then produce forecast results based on optimal statistical indicators (such as MSE index). Machine learning can only predict accurately within the input data range, while predicting outside the analyzed data range will give results with low accuracy. Therefore, empirical formulas still have certain advantages, especially forecasting trends outside the data range or areas with sparse data. Machine Learning is used for studies on object classification or regression prediction.

Machine Learning is a solution applied to many fields and industries, from social sciences, information technology, finance, medicine, remote sensing, electronics, robotics and other engineering fields. In this scope, analyzing the studies that have applied Machine Learning algorithms in the field of water resources and hydraulic engineering. This study will be based on machine learning algorithms on regression.

2. Related works

Study on applying Machine Learning algorithms to engineering, hydraulics have been synthesized and analyzed, the results have shown the usefulness of applying Machine Learning in the flow research, as Steven L. Brunton has overviewed Machine Learning and basic applications in fluid mechanics. It's shown that Machine Learning applications give good efficiency in the hydraulic research, it can support in evaluating physical models and sharing data better [2]. Melhem has analyzed Machine Learning solutions and applied in engineering with suitable databases, Machine Learning algorithm gives fast results and high accuracy [1]. In the analysis and calculation of flow for river basins, Corentin J. Lapeyre presented a machine learning solution in analyzing hydrological and hydraulic factors of river basins, to forecast water level and flow of Garonne River, France using Random Forest (RF) algorithms, 2D hydraulic model, multi-layer neural network (MLP), research to establish the relationship between Machine Learning model and 2D hydraulic model, to reduce costs for research and analysis of hydraulic characteristics of flow [3]. Elaheh White studied flow forecasting in some California rivers and streams, USA using RF model and evaluated by R2 > 0.8 [4]. Granata predicted spring flows in Rasiglia Alzabove, Umbria, Central Italy with DT and RF machine learning models for analysis and used the R2 evaluation index to achieve quite good results with R2 = 0.991 [5] or Ziyao Xu's water price analysis [6] predicted water price growth using the RF model in the US and used the R2 evaluation index for a value greater than 0.8, showing that Machine Learning helps in deciding on appropriate and rapid water price adjustments.

Studies show that the application of Machine Learning algorithms is still very limited, and its application has not been widely deployed like the application of neural networks (ANN) of Artificial Intelligence systems. Especially in the field of hydraulics and hydraulic engineering, there are also very few studies, which limits the ability to apply and expand the research database system. Making new research related hazard scenarios to reduce the likelihood of accidents during underground construction or operation; (ii) Implement geotechnical surveillance at different stages of urban underground projects, especially during construction and (iii) Complete legal instruments and regulations on risk management, risk control regulations, management plans, and related technologies in urban underwater construction. Since then, it has contributed to addressing some of the constraints encountered in unifying policies and regulations on the implementation and exploitation of urban underground buildings in future Vietnamese municipalities./.

References

1. *Ministry of Construction (2009), Urban Underground Development in Vietnam, Electronic Portal Construction, 2009, https://moc.gov.vn/, published on October 7th, 2009.*
2. *Nhan Dan Online Magazine (2024), Vietnam's urban system develops strongly in quantity and quality, Nhan Dan Online Magazine, 2024, https://nhandan.vn/, published on January 19th, 2024*
3. *Giang Nguyen Cong, Truong Nguyen Huy, Lan Bui Thi Ngoc, and Xuan Nguyen Phuc (2024), Risk management in Urban underground construction, Construction Publisher, published in April 2024.*
4. *Debasis Sarkar, Goutam Dutta (2011), A Framework of Project Risk Management for the Underground Corridor Construction of Metro Rail, Indian institute of management, Ahmedabad-380 015, India, published in February 2011*
5. *A.P.F.Bourget, E.Chiriotti, E.Patrinieri (2019), Evolution of risk management during an underground project's life cycle, Tunnels and Underground Cities: Engineering and Innovation meet Archaeology, Architecture and Art – Peila, Viggiani & Celestino (Eds), Taylor & Francis Group, London, ISBN 978-1-138-38865-9, 2019*
6. *Heinz Ehrbar (2024), Project risk management in underground construction, German Committee for Underground Construction, 2024, published on March 20th, 2024*
7. *Lebedev Mikhail, Romanevich Kirill (2022), Risk management in the development of underground space in Russian cities, RT&A, Special Issue № 4 (70) Volume 17, November 2022*
8. *Qihu Qian and Peng Li (2016), Safety risk management of underground engineering in China: Progress, challenges and strategies, Journal of Rock Mechanics and Geotechnical Engineering, doi: 10.1016/j.jrmge.2016.04.001*
9. *Nhan Dan Online Magazine (2022), Hanoi publishes draft underground space planning, Nhan Dan Online Magazine, 2022, https://nhandan.vn/, published on April 12, 2022.*
10. *Minh Quan (2024), Expanding the Underground Space in the Center of HCM, Online Labour Newspapers, 2024, https://laodong.vn/, published on January 24, 2024.*

Some safety issues in construction of climbing formwork system...

(tiếp theo trang 60)

attention and level of control to each one. The risk is the chance that somebody could be harmed by these hazards, as well as the potential severity of harm.

Implement measures to control risk

The greatest risk should be addressed first. If you cannot eliminate a risk, you'll need to implement control measures to minimize it. The hierarchy of controls can help you select and implement more effective measures to control risks.

Communicate

Make sure everyone is aware of your risk management program. Provide managers, supervisors, and workers with orientation and training on how to identify hazards and what to do to control the risks. Document and share your safe work procedures and policies with workers.

Monitor and update

Monitor the effectiveness of the control measures in place and improve those that are not working as intended. Look for new or changing hazards and risks when you conduct your regular safety inspections, and make sure you are observing and supervising work activities that have a higher level of risk.

Partner Collaboration and Government:

Establish a collaborative environment among stakeholders including contractors, engineers, project managers, and government agencies. Effective collaboration ensures compliance with safety regulations and standards, as well as optimizing construction processes and project management.

Conclusion and Future Directions:

In the future, continued research and development of new safety solutions are essential to ensure the safety of workers and the construction efficiency of high-rise buildings. Risk management and safety training will also play a crucial role in promoting progress and development in the construction industry in the future./.

References

1. *QCVN 18: 2021/BXD - National Technical Regulation on Safety in Construction.*
2. *TCVN 13662:2023Scaffolding - Safety requirements*
3. *TCVN 5308:1991 Code of Practice for building safety technique*
4. *(United States): OSHA Standard 1926 Subpart L: Safety and Health Regulations for Construction - Scaffolds.*
5. *Nhật Bản: JIS A 8961: Japanese Industrial Standard for Construction Work - General Rules for Scaffolds.*
6. *(European Union): EN 12810-1:2018: Temporary works equipment - Part 1: Scaffolds - Performance requirements and general design.*
7. *EN 12811-1:2003: Temporary works equipment - Part 1: Scaffolds - Performance requirements and general design.*
8. *EN 12812:2019: Temporary works equipment - Requirements and test methods - Prefabricated scaffolds.*

Social housing for workers and laborers in Ha Long city: status quo and solutions

To Thi Huong Quynh[1], Vu Phuong Ngan[2*]

Abstract

Ha Long City, the administrative, political, cultural, commercial, tourism, and service center of Quang Ninh Province, is experiencing rapid growth and urbanization, attracting many investors to implement projects that transform both urban and rural landscapes. However, in contrast to this development, many disadvantaged groups in society, such as workers and low-income laborers, are facing difficulties in accessing housing projects. Recently, housing for these groups has not received adequate attention, and efforts to support the implementation of social housing projects and attract high-quality human resources are still facing many challenges. This study investigates the current state of social housing for workers and laborers in Ha Long City. Based on the findings, the authors propose several solutions to help address the existing shortcomings in the development of social housing in Ha Long.

Key words: social housing, workers, low-income laborers, Ha Long

[1] Faculty of Construction Economics and Management, Hanoi University of Civil Engineering
[2*] Faculty of Urban Management, Hanoi Architectural University,
Email: nganvp@hau.edu.vn
Tel: 097 5659 357

Date of receipt: 19/8/2024
Editing date: 12/9/2024
Post approval date: 04/11/2024

1. Introduction

Housing is a construction project aimed at providing living spaces to meet the residential needs of families and individuals. It serves as a place for the reproduction of labor and the development of human resources. Addressing housing issues effectively contributes to social welfare, as housing needs are a top priority for households, especially for those seeking to improve their living conditions. In recent years, the Party and the State have placed significant emphasis on housing development, affirming that "Housing development is one of the crucial aspects of socio-economic development policy"[1].

Ha Long City boasts favorable conditions such as geographic location, land, mineral resources, and tourism. Coupled with decisive leadership and direction from the party committees and authorities at all levels, the city has achieved remarkable socio-economic growth. Alongside this growth, the demand for housing from residents, workers, and investors has increased significantly. In response, numerous commercial housing projects and new urban areas have been implemented and established, such as the Vu Dung Urban Area, Cao Xanh - Ha Khanh A, B, C Urban Area, Lan Be - Column 8 Urban Area, Hung Thang Urban Area, Staff and Worker Housing in Thong Nhat Commune, and the Residential Area in Cho Village, Thong Nhat Commune. This has led to the phenomenon of "hot development" of commercial housing projects and urban areas. However, this development contrasts with the fact that many disadvantaged groups (such as workers in concentrated industrial zones and coal industry workers) find it difficult to access commercial housing projects and new urban areas. To address this, Quang Ninh Province has simultaneously approved the Housing Development Program until 2030 [2],and the Housing Development Plan until 2025[3]for the entire province. The province is also researching and developing a proposal to build housing for workers, laborers in the coal industry and industrial zones, and attract high-quality human resources and skilled workers to live and work in Quang Ninh. Despite these efforts, the implementation of social housing projects has faced significant challenges. Therefore, the authors believe that studying the current state of social housing projects in Ha Long City is crucial to identifying the limitations and obstacles hindering their implementation. Based on this research, the authors propose several measures to promote the development of this type of housing.

2. Status quo and Limitations in Developing Social Housing for workers and laborers in Ha Long City

2.1 Status quo of social housing, housing for workers and laborers

In recent years, the workforce migrating to Ha Long City for living and working has been on the rise. Safe, stable, and long-term housing is essential for workers to focus on their jobs and maximize productivity. Among these groups, special attention needs to be paid to workers in key economic sectors, such as those in the coal industry, industrial zone workers, high-quality labor, low-income urban workers, service-tourism workers, and policy beneficiaries facing housing difficulties.

As of now, in the total number of social housing development projects for workers approved in the Social Housing Development Plan in Ha Long City for the 2015-2020 period according to Decision No. 2003/QD-UBND [4], only one project (a 5-story apartment complex in Cao Xanh Ward by Hon Gai Coal Company) has commenced construction but is not yet completed (one 5-story block remains unfinished). One project is in the preparation stage (the trade union facilities project on Thuy San Hill, Bai Chay Ward, Ha Long City - converted from a social housing project at plot N0 in Thuy San Hill Villa Area, Bai Chay Ward); one project has not