Study on the evaluation index system of green construction of pile foundation

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Abstract: The green construction is the direction that civil engineering can realize sustainable development, there is no specific inferior index about green construction global frame in '*Green Construction Guideline* ', it is the important condition than can conduct the evaluation about green construction by establishing a set of scientific, feasible index system about the green construction of pile foundation. This paper is based on the construction of pile foundation, combines the global frame of green construction, and establishes the index system about the construction evaluation on green construction of pile foundation.

Introduction

'*Green Construction Guideline*' was released in September 2007 by ministry of construction, it puts forward that green construction appears in engineering construction, it is based on the precondition about a set of essential requirements such as promising quality, safety, we can save resources furthest and reduce the construction activities that are influential to environment by scientific management and technical progress ,can realize energy conservation, land saving, water saving, material saving and environment conservation. The guideline introduces the main content about green construction that contains 6 aspects: construction management, environment conservation, material saving and material resources utilization, water saving and water resources utilization, energy conservation and utilization, land saving and construction using land conservation. These aspects constitute the global frame about green construction, and cover the essential index about green construction.

We can find that the index in the global frame of green construction not always fit for the construction characteristics in partitioned project, such as the evaluation in the pile foundation construction about the structural materials, maintaining materials, decorative materials. So, the problem we need to do is how to combine the characteristics of pile foundation construction, modify and optimize the exiting evaluation index system of global frame of green construction. The pile foundation construction has bad influence on surrounding, such as hammering method, noise produced by vibration pile, vibration and squeezing effect and so on. This paper is based on the pile foundation construction, analyzes construction of pile foundation, and establishes a set of essential evaluation index system of green construction.

Establishment of evaluation index system of green construction of pile foundation.

The selection and confirmation of this system is the basic and key for evaluation content, direct influences the precision and result of evaluation. This system is resolved in 2 grades in this paper. There are 6 first grade indexes: construction management, environment conservation, material saving and utilization, water saves and resources utilization, energy conservation and utilization and land saving and construction uses land conservation. The 28 secondary indexes correspond first grade indexes, mainly include：

1.Construction management (R_1)

Construction management (R_1) mainly includes 5 aspects: Organizational management (R_{11}), planning management (R_{12}), implementation management (R_{13}), evaluation management (R_{14}) and personnel safety and health management (R_{15}).

Organizational management (R_{11}): establishing a leading group about green construction of pile foundation that project manager is the person in charge, and points out the manager of green construction.

Planning management (R_{12}): applying ISO14000 and ISO18000 management system, resolving the context of green construction of pile foundation into aim of management system, normalizing and standardizing the green construction; organizing the special scheme of green construction of pile foundation,"Four saving and one environmental protection"are complete in project.

Implementation management (R_{13}): pointing management control objectives of green construction of pile foundation, and resolving it into each stage and relative manager.

Evaluation management(R_{14}):systematic evaluation methods of green construction of pile foundation, setting respectively "four saving and one environmental protection"control index.

Personnel safety and health management (R_{15}): carrying out '*Occupational Health and Safety Management System Specification*', and '*Environment Management System Requirement and Guideline*'.

2.Environment conservation (R_2)

Environment conservation(R_2) mainly includes 7 aspects: advanced pile foundation construction machinery and equipment(R_{21}),new technology, new craft, new methods of green construction of pile foundation(R_{22}), noise and vibration control(R_{23}), waste water, effluent, mud control(R_{24}),dust, flue gas control(R_{25}), construction waste control(R_{26}) and setting underground cultural relics and resources conservation(R_{27}).

Advanced pile foundation construction machinery and equipment (R_{21}): includes advancement of drilling equipment, pile machine equipment and other equipment. Owing to the particularities of pile foundation, whether pile driving method, perfusion or stirring produce vibration and noise. Advanced, environmental, low-energy, low-noise pile foundation construction machinery and equipment, can not only increase the construction efficiency, but also low project cost, shorten time limit for a project, lighten labor strength and so on; for example, hydraulic hammer replace diesel hammer step by step, press pile replace driven pile for lesser pile, both reduce effect on environment in densely populated area, contributing to green construction.

New technology, new craft, new methods of green construction of pile foundation(R_{22}):the use and popularization of it not only can increase construction efficiency, produce good economic benefits, but also can reduce the pollution and destruction that the process of pile foundation construction contribute to environment, such as applying steel casing process, rotary-drill, long or short spiral soil process, craft dig-hole pile process and the rigid pile construction and so on, all can increase efficiency, reduce the destruction to environment.

Noise and vibration control(R_{23}):pile foundation construction would produce noise, especially the driven pile, we should adopt measures to reduce noise, such as sound source control, shield, protecting facilities and controlling the construction time and so on; driven pile and vibration pile would produce vibration, and cause varying degrees destruction to near foundations and building. We should adopt changing construction craft, setting damping wall, damping hole, reinforcement protection measures, the emission of spot noise is less than the national standard in'*Noise Limits for Construction Site*'*(GB12523)*.

Waste water, effluent, mud control (R_{24}): pile foundation construction produce waste water, effluent and mud, Construction site would set drain, sump, sedimentation basin, or recycle these waste or transport to mud station or assigned mud abandon station.

dust ,Flue gas control(R_{25}):flexible pile construction produce dust, we should adopt measures of dust prevention, such as covering, bagging for those raw material is easy to produce dust pollution; construction machinery and other equipment produce flue gas, adopting environmental protection equipment and clean energy to reduce atmosphere pollution.

Construction waste control (R_{26}): the recycling and recovering of construction waste reach a certain percentage.

Setting underground cultural relics and resources conservation (R_{27}): Protecting the construction site and the surrounding underground facilities. Ensure safe operation of all kinds of pipelines, pipelines, buildings and structures.

3. Material saving and material resources utilization (R_3)

Material saving and material resources utilization(R_3) mainly includes 4 aspects: material saving measures(R_{31}), conservation and utilization of materials and human resources(R_{32}), land saving of construction machinery, pile processing and temporary storage(R_{33}) and the dealing and recycling of construction waste(R_{34}).

Material saving measures (R_{31}): making material saving measures in terms of ensuring the safety and quality of pile foundation construction, such as optimization of saving material construction scheme optimization, reducing construction waste, utilizing recycling materials, and reducing material loss rate.

Conservation and utilization of materials and human resources (R_{32}): the development of pile foundation is hollow pile and high strength pile, adopting high strength bar and high strength concrete for material saving, adopting modern construction machinery and construction ways for labor saving.

Land saving of construction machinery, pile processing and temporary storage (R_{33}): reasonably arranging the purchase, approaching time and lot of material on the basis of construction progress, stock and others, reducing stock and temporary storage land, reducing repeated handling.

The dealing and recycling of construction waste (R_{34}): the waste water, effluent, oil fouling and mud would effect surrounding and the lives of residents without timely treatment in pile foundation construction produced. For example, slurry in filling pile would cause great harm to surrounding, so we must deal and recycle mud or transport to assigned abandon soil field.

4. Water saving and water resources utilization (R_4)

Water saving and water resources utilization (R_4) mainly includes 4 aspects: water saving measures (R_{41}), improvement of water use efficiency(R_{42}), utilization of nontraditional water(R_{43}) and water safety(R_{44}).

Water saving measures (R_{41}): making water saving measures in terms of engineering local water resources condition, choosing water saving technology, equipment and tools, reducing waste of water resources, strengthening the management of water saving, setting water quota system and optimizing the water supply and drainage system.

Improvement of water use efficiency (R_{42}): adopting advanced water saving construction technology, improving water use efficiency.

Utilization of nontraditional water(R_{43}):giving priority to adopt nontraditional water for washing machines, equipment, cars, road spraying and greening irrigation, as far as possible do not apply tape water .Establish a collection and utilization system of rainwater, reclaimed water and reuse water. Nontraditional water and recycled water reuse amount gradually increased.

Water safety (R_{44}): adopting effective water quality detection and health safeguard measures during the use procedure of nontraditional water and recycled water to prevent the bad effect on human health, project quality and surrounding environment.

5. Energy conservation and utilization (R_5)

Energy conservation and utilization (R_5) mainly includes 4 aspects: energy conservation measures (R_{51}), mechanical equipment and machinery (R_{52}), temporary facilities of production, life and work (R_{53}), construction electricity and lighting (R_{54}).

Energy conservation measures (R_{51}): conducting the construction energy conservation planning, setting goals, making energy conservation measures. The pile foundation construction would consume lager electric energy, so need to set saving electricity scheme. Setting reasonable construction energy consumption indicators, and improving the utilization rate of energy.

Mechanical equipment and machinery (R_{52}): setting construction machinery and equipment management system, keeping maintenance, keeping mechanical equipment low consumption, efficient. Choosing power and load match construction machinery and equipment, avoiding high

power long time low load operation of mechanical equipment. Mechanical equipment should use energy saving oil additive. Recycling and saving fuel as possible.

Temporary facilities of production, life and work (R_{53}): rationally designing the figure, orientation, gap and area ratio of window of temporary facilities of production, life and work by utilizing conditions of the site, to get better sunlight, ventilate and lighting. Temporary facilities should utilize energy saving materials. The materials with good heat insulation performance used to wall, roof, reducing the hours of use and energy consumption of conditioner in summer, heating equipment in winter.

Construction electricity and lighting (R_{54}): temporary use of electricity priority selection of energy saving wire and energy saving lamps. Automatic control device for temporary electric appliance would use of. Energy saving lighting lamps are use of such as voice control and light-operated.

6. Land saving and construction using land conservation (R6)

Land saving and construction using land conservation (R_6) mainly includes 4aspects: land saving measures (R_{61}), temporary land use indicators (R_{62}), temporary land protection (R_{63}), and construction general layout (R_{64}).

Land saving measures (R_{61}): setting temporary land use indicators, general layout planning of construction and temporary land use in measures.

Temporary land use indicators (R_{62}): reasonably ensuring land allocation of temporary facilities on the basis of construction scale and field condition and other factors, improving the effective utilization of temporary facilities.

Temporary land protection (R_{63}): reducing destabilization of land maximum, protecting the surrounding natural ecological environment, utilizing and protecting the original green vegetation in scope of land for construction.

Construction general layout (R_{64}): setting reasonable construction general layout, reducing of use the construction of temporary land and land for temporary facilities, taking full advantage of original construction, structures, roads, pipelines for construction work. The setting of mixing plant, storage, fabrication plant, homework tent, material storage areas should close to original traffic route or building formal or temporary traffic route, shortening transport distance.

The evaluation index system above is the main evaluation index of green construction of pile foundation. We could conduct adjustment and optimization for specific pile foundation construction. Giving every index a certainly weight coefficient, adopting effective evaluation ways in terms of different engineering characteristics after establishing evaluation index system of green construction of pile foundation, green evaluation becomes a reality in green construction of pile foundation.

Conclusions

The construction evaluation of green construction of pile foundation is a complex project, it involves many aspects. The establishing of evaluation index system of green construction of pile foundation in this paper mainly studies the important index that can affect green construction of pile foundation. The evaluation index system has a certain commonality. Each project is located in the area and the characteristics of different, the evaluation index system is not the same, and the establishment of the index system of a complete, comprehensive pile foundation level of green construction, for further research is needed.

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