Research on composite caisson foundation under desert geological condition in Xinjiang

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Abstract

Based on the project of the HuaiBei~WuBei double circuit 750kV transmission line engineering, the modular design and key technology research for construction of composite caisson foundation in the Xinjiang desert region is carried out.The applicable type, design method and construction technology of modular design for composite caisson foundation of 110~750kV transmission line on desert foundation are put forward.

Keywords

Wuzhun line; desert; composite caisson foundation; research.

1. Engineering profile

HuaiBei~WuBei double-circuit 750kV line project (hereinafter referred to as "ZhunWu 750kV line") started in planned HuaiBei transformer substation in XiaZigai Hebukesai'er, via Hefeng county, 184th Regiment of 10th Division, Changji, Fukang, Urumqi Municipality and other major counties and cities, ended in WuBei transformer substation in Midong District.The Section II of ZhunWu 750kV line from Mitigainhaltropogi in the Gurbantunggut Desert to the intersection of SW road and SN 31 well area.

Almost all of whole line is located in the hinterland of Gurbantunggut Desert,which mostly are located on the sand dunes. The construction conditions are complex and the natural conditions are harsh.The tenders with a total of 266 radical of towers is set up in two parallel single loops,the I of which is 63.660km, 133 radical of towers, and the II loop is 63.386km,133 radical of towers.

2. The purpose and significance of the research

Xinjiang covers an area of 1.66 million square kilometers, of which mountainous, desert and Gobi accounts for 84%,Xinjiang has vast territory and lack of water resources,The construction of transmission line engineering in desert area is faced with many difficulties, such as the difficulty of on-site pouring of foundation concrete,long-distance raw material transportation, the huge amount of excavation and low degree of mechanized construction.So,the systematic study of the theory and experiment of composite caisson foundation in the desert region is carried out.and the modularized and standardized design and construction technology of composite caisson foundation of transmission line in Xinjiang desert region are achieved eventually.It is conducive to shortening the construction period of transmission lines and reducing investment in transmission lines, It also is of great research significance for promoting transmission line construction and environmental protection in Xinjiang.

3. The Status Quo and Development Trend of Research Level at Home and Abroad

At present, the design module of various voltage levels（110~750kV） of transmission line towers has been formed, marking standardized and serialized typical design of transmission lines in China's power grid infrastructure has made important achievements.Because of the complexity of the

geological conditions around the world,relevant research institutes both at home and abroad have little understanding of the types, calculation models and parameter values of composite caisson foundation in desert areas. So far there is no design and construction technology for composite caisson foundation in China.

Aiming at the desert area where water resources are scarce in Xinjiang, the prefabricated composite caisson foundation can solve the problem of transportation of materials such as water shortage or lack of sand,at the same time,the composite caisson foundation of standardization, modularization and mass production can improve the construction quality of desert area and the construction efficiency and mechanization construction level of transmission lines in Xinjiang.

4. Research Content and Execute Solution

4.1 Research Content

Issue:Research on Modular Design and Construction Technology of Composite Caisson Foundation in Desert Area

The type, calculation model, design method, bearing performance test and construction technology of composite caisson foundation of 110~750kV transmission line in desert region are studied.

According to the demarcation principle and standard of the design load classes of the tower foundation of Xinjiang 110~750kV transmission line, the structure type of composite caisson foundation of transmission lines in desert regions is studied.The computational model of composite caisson is put forward.The indoor experiment and field test of typical composite caisson foundation for transmission lines in desert are carried out.Combined with the characteristics of long distance transportation in desert area of Xinjiang, the paper researches the prefab manufacturing and assembly technology of composite caisson foundation,The construction technology of composite caisson foundation can be studied from the aspects of site installation, component corrosion prevention, environment and soil and water conservation, engineering acceptance, etc. A modular design drawing of composite caisson foundation in Xinjiang desert region will be formed.

4.2 Execute Solution

The block diagram of the modular design and construction technology of the composite foundation caisson transmission line in desert area is shown in figure 1.

Step 1:Distribution Features of Xinjiang Desert Area and Its Main Physical and Mechanical Parameters

①Research on distribution characteristics of Xinjiang desert：

The distribution and mechanical properties of desert areas in Xinjiang were investigated and the mechanical parameters of sand and soil accumulated in highway construction and railway construction in desert areas were collected.

②Desert information research in Xinjiang:The distribution characteristics and main physical and mechanical parameters of desert in Xinjiang are collected from the geotechnical investigation report of power transmission line, foundation design calculation, construction drawing of foundation and foundation construction organization design aspects.

Step 2:Research on the type, calculation model, design method, bearing performance test and construction technology of composite caisson foundation of 110~750kV transmission line in desert region.

①Type selection of composite caisson foundation in desert region:According to the 110~750kV transmission line engineering load characteristics in Xinjiang desert area, combined with the fundamental type of running line to carry out research of the transmission line composite caisson foundation from the line operation, the type of foundation,basic corrosion and so on,put forward

suitable for desert region in Xinjiang, 110 ~ 750 kV power transmission lines in composite structural style of the open caisson foundation.

②Study on calculation model and design calculation method of composite caisson foundation in desert area:The design and calculation model of composite caisson foundation suitable for desert area in Xinjiang need to be studied and the design and calculation method of composite caisson foundation need to be proposed.

③Bearing performance test of composite caisson foundation in desert area:Carrying on indoor model test of composite caisson foundation to study the force characteristics of each component.Under the typical desert geological conditions of 220 kV, 500 kV and 750 kV transmission lines in Xinjiang, the field bearing capacity tests of uplift, down-press, uplift+level of composite caisson foundation are carried out.

④Study on construction technology of composite caisson foundation in desert area:Researching composite caisson foundation prefabrication processing and field assembly technology,puting forward the construction requirements of the composite caisson foundation for hoisting, transportation environment and surrounding traffic environment,and the construction techniques of composite caisson foundation need to be studied from the aspects of hoisting and sinking, site installation, component corrosion, environment and soil and water conservation, engineering acceptance, etc.

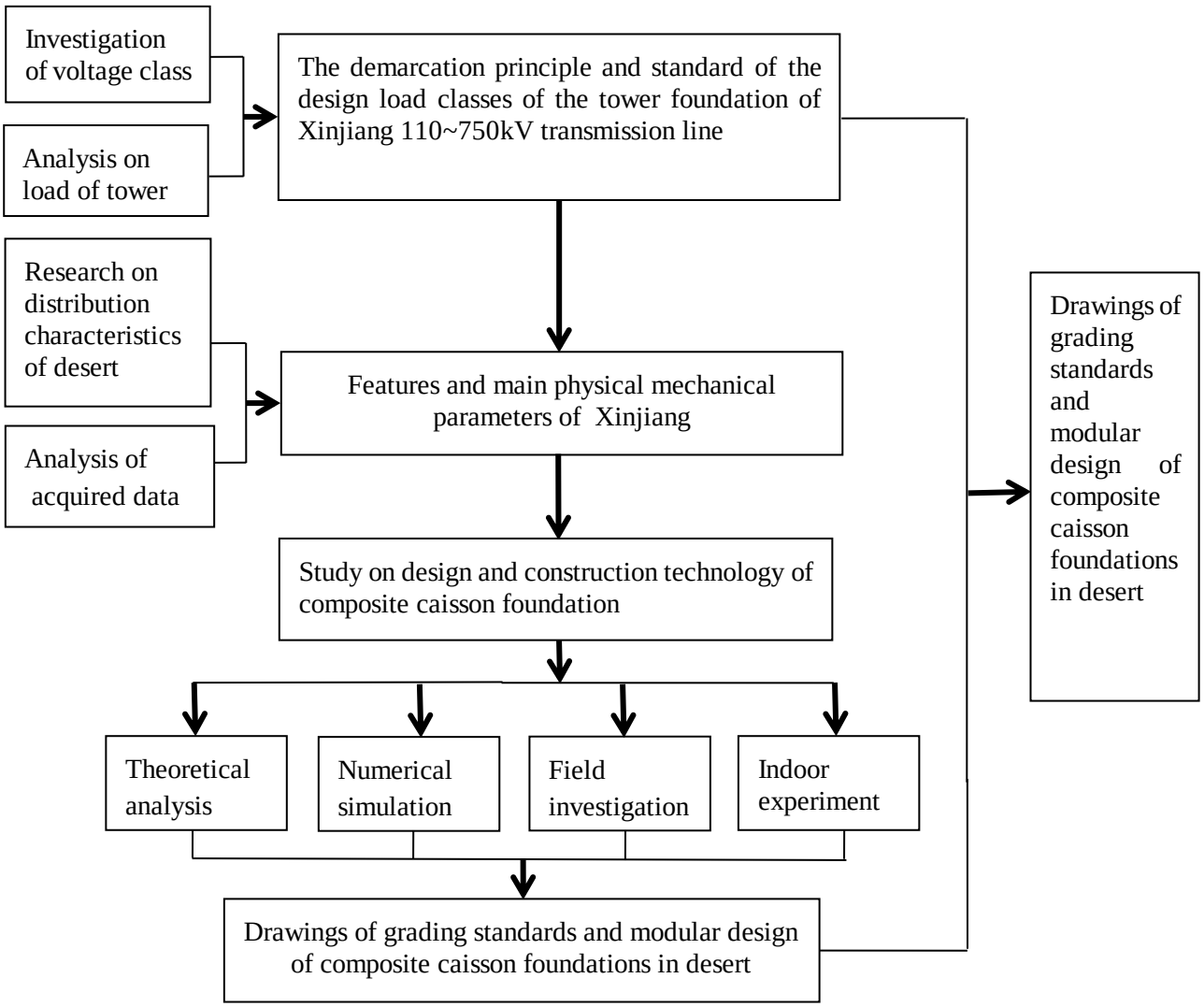


Fig.1 the block diagram of the modular design and construction technology of the composite foundation caisson transmission line in desert area

Step 3:Modular design of transmission line in Xinjiang desert region

①The principle and standard of the designed load level of the tower foundation of the 110-750kv transmission line in Xinjiang:The sub-principles of class of loading and classification module standard of transmission tower foundation to be researched according to the investigation results of voltage grade and tower load of transmission line Xinjiang area.

②Modular design of transmission line in Xinjiang desert region：According to the principle and standard of load level design for tower foundation design of 110~750kV transmission line in Xinjiang, the structural dimension of composite caisson foundation is designed and the modular design drawings of composite caisson foundation are formed.

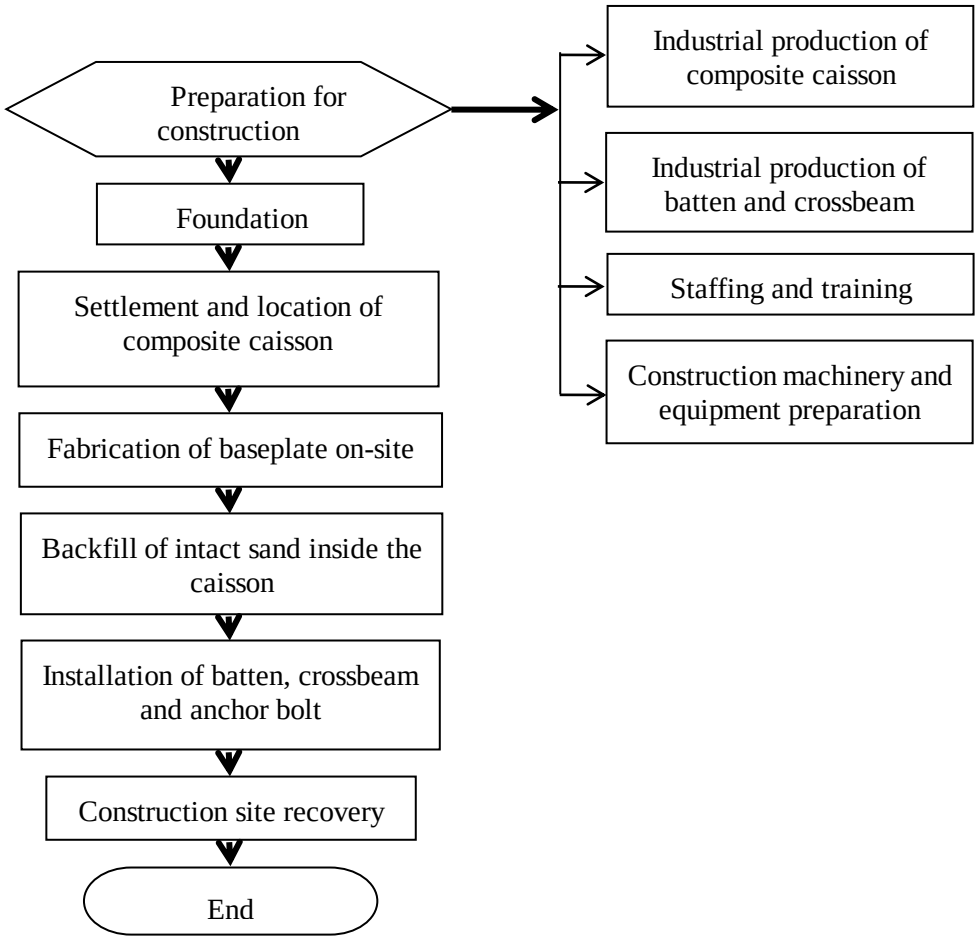
The test scheme of desert foundation in Xinjiang is shown in table 1.

Table 1 Test scheme of composite caisson foundation for transmission line in Xinjiang desert

soil texture	foundation type	test sample	test conditions
	composite caisson foundation	1	uplift
		1	down-press
		1	uplift+level
The number of test sample		3	

5. Site construction applications and experiments

5.1 The process of construction technology



5.2 Steps of site construction :

5.2.1Industrial production of composite caisson batten and crossbeam

5.2.2Settlement and location of composite caisson

5.2.3Fabrication of baseplate on-site and backfill

5.2.4Installation of batten, crossbeam and anchor bolt

6. Conclusion

Based on the research of ZhunWu750kV line desert composite caisson foundation, the paper forms the research report on the design calculation method of composite caisson foundation in Xinjiang desert,and the modularized design drawing of composite caisson foundation of 110~750kV transmission line in Xinjiang desert area is accomplished.The construction technology of composite caisson foundation in Xinjiang desert area was completed in the typical test site.

Acknowledgements

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