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Hydraulic Lifting of Steel Box-Girders for Humen Bridge

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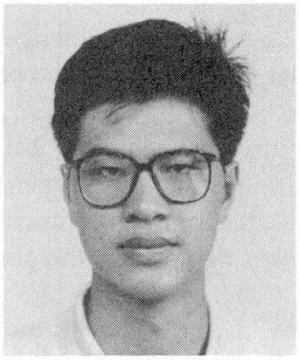

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Abstract:

Taking Humen Bridge of Guangdong in China for example,the article elaborates the new technology for steel box-girder-----hydraulic lifting technology,and includes applicational process、critical constructional technology、equipments as well as economic effect analysic.

1.Introduction

Humen Brige in Guangdong is a suspension bridge with a span of 888m.The reinforced steel box-girders are manufactured in factory by section. Standard sectional steel box-girder of each erecting unit is 24m in length,312t in weight.The erection of steel box-girder is one part of critical technology applied in the construction of upper structure for long span suspension bridge, winch cable-spanned crane are used in traditional erection.such hoisting structure is made up of wirerope、block and tackle、winch,featuring simple operation.mature technology and fast speed.Nevertheless it also has the following drawbacks:

(1)Lifting capacity is limited by wire rope、block and tackle and winch.For with the addition of lifted weigth,it is necessary to increase the diameter of wirerope and the multiplying power of block and tackle,which makes it difficult to satisfy structural requirements.

(2)It is affected greatly by the span of suspension bridge,For winch is generally placed on earth surface,with the increase of suspension bridge span and tower boby it is required to have long enough wire-rope,which makes the construction costs higher.

(3)Wide operating rang and different lay out of winch、lifting beam and hoisting weight cause the problems of communication and coordination.

in consideration of abve reasons it is necessary to search a new lifting method with regard to the lifting of sectional steel box-girder through deep research the new lifting technology for steel box-girder---hydraulic lifting technology adopting hydraulic lifting system for lifting structure instead of wirerope、block and tackle、winch,comes into the world.It needs continuous lifting jack as main unit and has been successfully applied for the project of Humen Bridge.

2.Constructional process of hydraulic steel box-girder lifting for Humen Bridge.

Adopt four 200t continuous lifting jack、two high-flow pump stations、one set of control system

and other relevant clamps as hoisting system.the process is as follows:
(1)Positioning and debugging of cranes:first position the cable-spanned cranes for hydraulic lifting,then debug hydraulic lifting system with full load to ensure the operation of each part is in accordance with design requirements.
(2)Lowering of the sling:release safe anchorage and two sets of wedges for continuous lifting jack.then lower the sling to water surface with four supplementary winches and connet with temporary hoisting point of steel box-girder.Finally release the binding rope used for transporting steel box-girder.
(3)Lifting of the steel box-girder:lift steel box-girder automatically and continuously.At the same time retrieve strands and make some adjustment for girder body horizontally if necessary.
(4)Installing of steel box-girder and boom:after lifing box-girder to place with continuous lifting jacks dischange load from jacks,which makes boom carry the girder's weight.It is the end of steel box-girder hoisting.

3.Critical technology for hydraulic steel box-girder lifting

(1)Uniform force carried by multiple strands:blank in equivalent length and mark at stipulated point,then install dead anchorage on the same point of each long enough strand.When strands are lowered together with sling,they remain equivalent length appoximately. So the pretighening problem is settled.
(2)The second lifting of upside-down cable
Because of the hoisting job practice strands need using repeatedly.With the help of winch on tower top the retraction of strants is achieved.
(3)Attached anchorages and clamps stipulated in job practice must be placed as rules require to ensure safe and reliable hoisting.
(4)Enough lifting speed and synchronous control make the technology widely applicable.

4.Economic effect analysis about using hydraulic lifting technology to hoist steel box-girder

Two sets of cable-spanned crane hoisted by winch and another two by hydraulic system were used in Humen Bridge.According to statistics gross weight of the former is 249t,the latter 100t,as a result that the use of the latter brings about the save of 149t material and ￥5,000,000 investment.Moreover,the change in design structure has led to the reduction of ￥1,000,000 investment on load test and 15 days for installation.

5.Conclusion

We have concluded the following by engineering practice.
(1)The hydraulic lifting technology for steel box-girder has the advantage of being not affected by the span of suspension bridges、lifting much heavier objects、simple structure、concentrative operating range and lower construction cost.so it is completely feasible.
(2)With regar to the future construction, it is considerable to add the length of steel box-girder section and decrease the joints number,which can shorten construction term and thus reduce costs.