Design and Construction of Operation Bridge for Research Reactor

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1. Introduction

The operation bridge is a gantry type crane system with a working deck for handling of equipment in pool such as nuclear fuel, reactor components, and reactor utilization facilities. The operation bridge allows operators to work on upper side of the pool.

2. Design

2.1 Structure

The operation bridge contains a lower working deck mounted on a saddle that travels on rails. Upright members are mounted on the saddle to support the upper structure and two hoist monorails. The saddle contains an anti-derail system that is composed of seismic lugs and guide rollers. The operation bridge travels along the rails to transport the fuel assembly, irradiated object, and reactor components in the pools by using tools. Hoists are installed at the top girder. The hoist is suspended from the monorail by means of a motor driven trolley that runs along the monorail. Movements of hoist and trolley are controlled by using the control pendant switch. All controls are on the pendant station and the control panel is mounted on the operation bridge. The controls provide a means for moving the bridge, the trolley, and the hoists. The traveling speed of the operation bridge has several steps. The speed of the hoist and the trolley has several steps in both horizontal and vertical directions.

Fig. 1 Configuration of operation bridge

2.2 Safety

The main parts of the operation bridge are made of carbon steel. The operation bridge is designed to prevent dust and oil from falling into the pool.

The operation bridge has safety devices to prevent abnormal operation due to human errors. Accessible area for the operation bridge on the pool top region is pre-defined. Motions of the operation bridge are strictly restricted by limit switches or sensors. Any simultaneous operation of hosting, trolley traversing, and operation bridge travelling is prohibited by an interlocking system for safety. The safety control functions are provided to prevent operators' errors or mistakes resulting in fuel delivery accidents that may cause damage to the fuel assembly. Stoppers are installed at the end of the rail to limit the travelling motion. Seismic lugs are installed to prevent derailment for safety.

Fig. 2 Limit switches

2.3 Analysis

All components of the operation bridge are designed to withstand dead load, live load, seismic load and combinations of loads during earthquake. KEPIC MCF (CMAA No. 70) and KEPIC MCN (ASME NOG-1) are used as a guide in the design for the operation bridge. [1-4]

It is confirmed through a structural analysis and evaluation that the operation bridge maintains structural integrity against all applicable design loads and load combinations for different hoist positions.

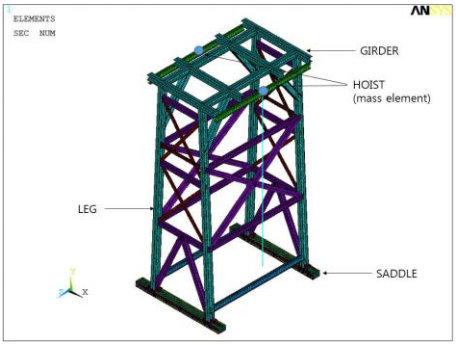

Fig. 3 FEM Model of Operation Bridge

3. Construction

3.1 Fabrication

The operation bridge is completely assembled as a unit in the shop to ensure proper fits of parts, alignment of bolts, tolerances, welding, and etc. Before disassembly and packing for transportation to the construction site, the operation bridge is inspected and tested. All surfaces are cleaned and the carbon steel surfaces are coated with the paint which is resistant to corrosion and irradiation.

3.2 Inspection and Test

The operation bridge is inspected and tested during fabrication and installation. In the commissioning stage, it is tested with related procedures or plans.

The operation bridge is tested with 125% lifted load of the rated load. The operating parameters of the motor, such as speed, voltage, and current, are checked during the performance test. The required function and operational limits of the operation bridge are tested according to the relevant test procedures. Dimensions of structures are inspected after the fabrication. Ultrasonic examination, magnetic particle examinations are performed on hooks, wheels, and shafts. Connections of bolts and welds are also inspected.

Fig. 4 Motor Performance Test

Fig. 5 Factory Acceptance Test

4. Summary

Processes of design and construction of the operation bridge for the research reactor are introduced. The operation bridge is designed under consideration of functions of handling equipment in the pool and operational limits for safety. Structural analysis is carried out to evaluate the structural integrity in the seismic events. Tests and inspections are also performed during fabrication and installation to confirm the function and safety of the operation bridge.

Acknowledgements

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REFERENCES

[1] Korea Electric Power Industry Code MCF, Korea Electric Association, 2005.
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