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Technical Code for Safety of Lifting in Construction

建筑施工起重吊装工程安全技术规范

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Technical Code for Safety of Lifting in Construction

1 General Provisions

1.0.1 This Code is formulated in order to implement the safety production policy and ensure the safety of crane lifting operations in architecture engineering.

1.0.2 This Code applies to crane lifting operations in construction of architecture engineering.

1.0.3 The crane lifting operations during construction of architecture engineering shall not only comply with this Code, but also comply with the relevant current national standards.

3 Basic Requirements

3.0.1 Before crane lifting operations, a special construction plan for the lifting operations must be prepared, and safety technical measures must be explained; during the operation, no changes may be made without the approval of the technical person in charge.

3.0.2 Special operation personnels such as crane operators, lifting signal workers, and rigging workers must hold special operation qualification certificates to work. Non-crane drivers are strictly prohibited from driving or operating cranes.

3.0.3 Before crane lifting operations, the used machinery, pulleys, hoist auxiliaries and ground anchors shall be inspected and must meet safety requirements.

3.0.4 Lifting personnels must wear non-slip shoes and safety helmets, and safety belts shall be worn when working at heights. They shall be fastened reliably and can be low-hanging.

3.0.5 The access road for lifting equipment shall be smooth and the bearing capacity shall meet the equipment access requirements. Obvious signs shall be set up around the lifting operation area; and non-operators are strictly prohibited from entering. It is not suitable to work at night. When it is necessary to work at night, there shall be sufficient lighting.

3.0.6 The upper end of the climbing ladder shall be fixed, the hanging basket and temporary workbench used at high altitude shall be firmly fixed; and a protective railing of no less than 1.2m shall be installed. The scaffolding boards of the hanging basket and workbench shall be flat and fastened; and probe boards are strictly prohibited. When lifting the operating platform, it is strictly prohibited to allow people to stand on the platform. When the components are hoisted, all personnel are not allowed to stand under the hoisted objects and shall maintain a certain safe distance.

3.0.7 The specifications of slings, snap rings, rope buckles, etc. used for tightening shall be determined based on calculations. Before hoisting, the crane steel rope, connecting parts and hoist auxiliaries shall be inspected.

3.0.8 When hoisting roof trusses and beams at high altitude and using oblique hanging to tighten lifting columns, anti-sway ropes shall be tightened at both ends of the components; and the operator shall control the balance and stability of the components.

3.0.9 The lifting points of components shall comply with design provisions. For special-shaped components or when there are no design provisions, calculations shall be made to ensure that the components are hoisted smoothly.

3.0.10 The materials of bolts, steel wedges, wooden wedges, steel pads and skids used for installation shall meet with the design requirements and relevant provisions of current national standards.

3.0.11 When hoisting large or heavy components or using new lifting techniques, a test lifting shall be carried out first; and only after confirming that there are no problems can the lifting be officially carried out.

3.0.12 Lifting operations shall be stopped in bad weather such as heavy rain, fog, heavy snow, and strong breeze and above. When carrying out lifting operations after rain or snow, the ice and snow shall be cleared away in time and anti-slip and anti-leakage measures shall be taken. Test lifting first and confirm that the brakes are sensitive and reliable before proceeding with the operation.

3.0.13 The hoisted components shall be ensured to be directly under the top of the crane boom. It is strictly prohibited to use diagonal pulling or diagonal lifting. It is strictly prohibited to lift components buried in the ground or bonded to the ground.

3.0.14 When the crane operates close to or travels under overhead transmission lines, the safety distance from the overhead transmission lines shall comply with the current industry standard JGJ 46 *Technical Specification for Temporary Electrical Safety of Construction Sites* and other relevant standards.

3.0.15 When dual-machine lifting is used, cranes of the same type or with similar performance should be selected. The load distribution shall be reasonable; and the load of a single machine shall not exceed 80% of the rated lifting capacity. The two machines shall work in coordination, and the hoisting speed shall be smooth and slow.

3.0.16 During the hoisting process, before the crane travels, rotates, tilts the boom, lifts and lowers the hook, etc., the crane driver shall sound the signal. It should perform only one action at a time; and wait until the previous action is completed before proceeding to the next action.

3.0.17 When starting to hoist, the component shall be lifted 200mm~300mm above the ground and then paused to check the stability of the crane, the reliability of the braking device, the balance of the component and the firmness of the tightening, etc.; and only after confirming that everything is correct, can hoisting be continued. The lifted components must not remain in the air for a long time. It is strictly prohibited to overload and lift heavy components and equipment with unknown weight.

3.0.18 It is strictly prohibited to walk or stand on the lifted components; do not use cranes to carry people; and do not stack or hang scattered objects on the components. It is strictly prohibited to work or walk under the lifted components or within the rotation range of the crane arm. When hoisting, the speed shall be constant and no sudden braking is allowed. The movement shall be smooth during rotation, and no reverse movement shall be made before the rotation fails to stop stably.

3.0.19 When operations are suspended, temporary holding or fixation measures must be taken for the parts of the lifting operation that have not formed a stable system.

4 Hoisting Machinery and Rigging Equipment

4.1 Hoisting machinery

4.1.1 All hoisting machinery that is newly purchased, overhauled, renovated, newly-installed, newly-used, or out of service for a period exceeding the prescribed time shall undergo technical inspection in accordance with relevant provisions and be used only after passing the inspection.

4.1.2 When the crane starts operating in each shift, it shall be tested for lifting first, and the operation can only be carried out after confirming that the brake is sensitive and reliable. It is not allowed to leave the post without permission and maintain the locomotive during operation.

4.1.3 The selection of the crane shall meet the requirements for lifting capacity, lifting height, and working radius. At the same time, the minimum rod length of the boom shall meet the operating requirements for lifting across obstacles.

4.1.4 The use of self-propelled cranes shall comply with the following provisions:

- 1** The parking position of the crane during operation shall maintain a safety distance from ditches and foundation pits according to the construction plan; and the crane must not be parked on a slope during operation.
- 2** Before operation, the outriggers shall be fully extended and the support pads shall be firm. The outriggers shall be adjusted when there is no load; and the boom shall be fully retracted and turned to the front or back before adjustment. If the outriggers are found to have subsided or other abnormal conditions during the operation, the hoisting objects shall be put down immediately and adjustments can be made before continuing the operation.
- 3** When starting, the main clutch shall be disengaged first. After the operation is normal, the main clutch shall be closed for no-load operation. After confirming that it is normal, the operation can be started.
- 4** The elevation angle of the boom during operation shall not exceed its rated value; when there is no corresponding information, the maximum elevation angle shall not exceed 78° , and the minimum elevation angle shall not be less than 45° .
- 5** The crane's amplitude shall be changed slowly and steadily; and rapid lifting and landing is strictly prohibited. Before the boom is stopped stably, it is strictly prohibited to change gears and perform two actions at the same time.
- 6** When the lifting load reaches or approaches the maximum rated load, it is strictly prohibited to lower the boom.

- 7 When a truck-type crane is carrying out hoisting operations, no one is allowed in the traveling cab, the hoisted objects are not allowed to pass above the cab, and driving with a load is strictly prohibited.
- 8 The expansion and contraction of the telescopic boom shall comply with the following provisions:
 - 1) The expansion and contraction of the boom shall be carried out before lifting. When expansion and contraction are required during lifting, the lifting load shall not exceed 50% of its rated value.
 - 2) The length of the upper boom after the boom is extended shall be no greater than the length of the lower boom; and the elevation angle of the boom after extension shall be no less than the corresponding specified value in the instruction manual.
 - 3) When extending the boom and lowering the hook at the same time, the minimum safety distance between the running and standing blocks in the instruction manual shall be met.
- 9 When the surface wear of the brake drum of the crane brake reaches 2.0mm or the wear of the brake belt exceeds 50% of the original thickness, it shall be replaced.
- 10 The safety protection devices such as the crane's amplitude indicator, torque limiter and limit switch shall be complete, flexible and reliable. It is strictly prohibited to adjust or dismantle them at will; and limit devices are not allowed to replace the operating mechanism.
- 11 After the operation is completed or before get off work, the operating lever shall be placed in the neutral position according to provisions; the boom shall be fully retracted to the original position, and turned to the downwind direction, and shall be lowered to between 40°~60°. Tighten the steel rope; hang the hook or drop the hook to the ground; then secure the brakes and safety devices; turn off the engine; and lock the cab before leaving.

4.1.5 The use of tower cranes shall comply with the relevant provisions in current national standards GB 5144 *Safety Code for Tower Cranes*, JGJ 196 *Technical Specification for Safety Installation Operation and Dismantlement of Tower Crane in Construction*, and JGJ 33 *Technical Specification for Safety Use of Construction Machines*.

4.1.6 The manufacture and installation of the mast crane shall comply with the following provisions:

- 1 Mast cranes shall be specially designed and manufactured, and can only be put into use after passing strict testing, trial operation and technical appraisal.
- 2 The groundsills, foundations, cables, balance ropes and ground anchor and other facilities during installation shall be determined through calculation. The angle between the

- 2 After the stress is applied from hoisting component to the hoisting chain, it shall be carefully checked to ensure that the gears are well engaged; and the self-locking device shall be effective before continuing the operation.
- 3 The chain shall be pulled evenly and gently, keep in the same direction as the wheel plate, and it shall not be pulled diagonally.
- 4 When the lifting capacity of the reverse chain or the weight of the hoisting component is unknown, only one person can pull the chain. If one person cannot pull the chain, the reason shall be found out. At this time, it is strictly prohibited for two or more people to pull the chain together.
- 5 The gear part shall be regularly lubricated; and the pawl, pawl spring and ratchet wheel shall be checked regularly to prevent brake failure.
- 6 After use, the reverse chain shall be disassembled, cleaned, lubricated, and put on a plastic cover after installation.

4.4.5 Lever hoists shall comply with the following provisions:

- 1 It can only be used for tightening balance ropes and lifting baskets during lifting.
- 2 Before use, it shall carefully check to confirm that the self-locking clamp device can reciprocate in a straight line after clamping the steel rope. If it does not meet the requirements, it is strictly prohibited to use it. When using it, it shall be checked to confirm that it operates freely after being stressed. Only when there are no problems can the operation continue.
- 3 When used in a hoisting basket, a safety rope shall be tied to each steel rope; and the other end of the safety rope shall be fixed on a reliable structure.
- 4 After use, it shall be disassembled, cleaned, oiled, installed and restored, and properly kept.

4.4.6 The use of jacks shall comply with the following provisions:

- 1 It shall be disassembled and cleaned before and after use. Damaged and non-compliant parts shall be replaced. After installation, the flexibility of the operation of various parts and accessories shall be checked. For hydraulic jacks, the integrity of the valves, pistons and leather bowls shall be checked; and the cleanliness and consistency of the oil shall meet the requirements. If used under negative temperature conditions, the oil shall not thicken or freeze.
- 2 The selection of jacks shall comply with the following provisions:
 - 1) The rated lifting weight of the jack shall be greater than the weight of the lifting components, the lifting height shall meet the requirements, and its minimum height shall be compatible with the installation clearance.

- 2) When using multiple jacks for joint lifting, jacks of the same model shall be selected and synchronized. The rated lifting capacity of each jack shall be no less than 1.2 times the shared weight.
- 3 The jack shall be placed on a flat and solid ground; and sleepers or steel plates shall be placed under the base. When in contact with the smooth surface of the lifted member, a hard wooden board shall be added to prevent slipping.
- 4 The force transmission at the top location shall be reliable; the force transmission center of the load shall be consistent with the axis of the jack; and load deflection is strictly prohibited.
- 5 When jacking up, lift it up slightly and then stop. Check the jack's load-bearing capacity, foundation, pads, and sleepers for any abnormalities or if the jack is skewed. If there are any abnormalities, it shall deal with them in time before continuing to work.
- 6 During the jacking up process, do not lengthen the jack handle at will or press hard. Each jacking height shall not exceed the mark on the piston; and the jacking height shall not exceed $\frac{3}{4}$ of the height of the screw rod or piston.
- 7 After the components are jacked up, temporary short wooden blocks shall be installed along with the sleepers; and the distance between the short wooden blocks and the components shall be kept within 50mm at all times.

4.5 Anchor

4.5.1 The structure of the vertical anchor shall comply with the following provisions:

- 1 Blocking wood shall be installed on the lower back side and the front side of the middle part of the sleepers, logs, and square wood ground dragon pillars; and shall be close to the earth wall. The pit shall be backfilled with earth and rocks and the surface shall be slightly higher than the natural floor.
- 2 The depth of the pit shall be greater than 1.5m, and the ground dragon pillar shall be 0.4m~1.0m above the ground and tilt slightly backward.
- 3 When using sleepers or square timbers as ground dragon pillars, the long side of the section shall be consistent with the force direction, and the applied load shall be perpendicular to the ground dragon pillars.
- 4 When the bearing capacity of the single-column vertical anchor is not enough, one or two single-column vertical anchor can be added behind the force-bearing direction and connected with ropes to jointly bear the force.
- 5 The structural parameters and calculation methods of various vertical anchor shall comply with the provisions of Appendix D of this Code.

5 Lifting of Concrete Structure

5.1 General Requirements

5.1.1 The transportation of components shall comply with the following provisions:

- 1 The transportation of components should strictly comply with the formulated transportation technical measures.
- 2 The transport road shall be smooth and have sufficient bearing capacity, width and turning radius.
- 3 When transporting components with a large height-to-width ratio, they shall be fixed using support frames, fixed frames, supports or reverse chains; and shall not be transported by hanging or stacking. The support frame shall be designed and calculated, and shall be stable, reliable and easy to load and unload.
- 4 When large components are transported by semi-trailers or flatbed trucks, steering devices shall be installed at the component supports.
- 5 During transportation, each component shall be fastened to the carriage.

5.1.2 The stacking of components shall comply with the following provisions:

- 1 The component stacking site shall be compacted and flat; and drainage ditches shall be set up around it.
- 2 The components shall be stacked stably according to the designed support position, and pad woods shall be provided at the bottom. For irregular columns, beams, and slabs, support and padding methods shall be specifically analyzed and determined.
- 3 Components with a high center of gravity such as roof trusses and thin webbed girders shall be placed upright. In addition to supporting pads, supports shall be provided on both sides to make them stable. The number of supports shall be no less than 2 runs.
- 4 Overlapping components shall be separated by skids, and the upper and lower skids shall be on the same vertical line. The stacking height of beams and columns should not exceed 2 layers; the stacking height of large roof panels should not exceed 6 layers. A 2m wide passage shall be left between stackings.
- 5 Prefabricated large panels shall be stacked using the inserting method or the back-to-back method; and the stacking rack shall be determined through design calculations.

5.1.3 The turning over of components shall comply with the following provisions:

- 1 When the column is turned over, it shall be ensured that it can withstand the positive and negative bending moments generated by its own weight. Its two ends are $1/5 \sim 1/6$ away from the end face, where it shall be padded with square wood or sleepers.
- 2 When the roof trusses or thin webbed girders are turned over, the crack resistance shall be checked and if it is insufficient, they shall be reinforced.

When the height of the roof truss or thin web beams exceeds 1.7m, tie wood, bamboo or steel pipe cross bars should be added to the surface to increase the plane stiffness of the roof truss, and square timbers or sleepers should be set at both ends of the roof truss. The upper surface should be flush with the bottom of the roof truss. Flat, and there should be no bonding between the roof trusses. When turning over, you should straighten it once or turn the roof truss to an angle of 70° with the ground before braking.

5.1.4 The assembly of components should comply with the following requirements:

- 1 When flat assembling is used, damage and deformation during the turning process should be prevented; when vertical assembling is used, reliable stabilization measures should be taken. When long-span members are assembled at high altitude, an assembly bracket with an operating platform should be set up.
- 2 When the modular roof trusses are vertically assembled, safety blocks should be installed on the assembled trusses.

5.1.5 The setting of lifting points and the tightening of components shall comply with the following provisions:

- 1 When the component does not have a designed lifting ring (point), the position of the tightening point shall be determined through calculation. The tightening method shall be reliable and unhooking shall be easy and safe.
- 2 When tightening the vertically lifted components, it shall comply with the following provisions:
 - 1) The position of the tightening point shall be slightly higher than the center of gravity of the component.
 - 2) When the column does not turn over or cracks does not occur during lifting, the oblique hoisting and tightening method shall be used.
 - 3) The skylight frame should be tightening at four points.
- 3 When tightening the horizontally lifted components, it shall comply with the following provisions:

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