APPLICATION OF GRADE II REINFORCED STEEL IN THE SHEARING WALL FRAME STRUCTURE OF JINJIANG GARDEN PROJECT

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Jinjiang Garden Project, located at riverside of Funan River in Chengdu, the capital city of Sichuan province, was designed by Sichuan Provincial Design Institute of Architecture in 2000 and has been already put into use. The great-based, twin-tower main building is of concrete shearing wall frame structure with 32 floors above ground and 3 floors under ground. The height of rooms is 99.90 m. The totally building is 115.30 m high, 114.489 m long with a 3-floor skirt building. Floors 1~3 are for supermarket, floors above are for living. The living rooms are of shearing wall structure while floors 1~3 are of tube-shaped frame structure. A structure conversion has been built on floor 3 for conversion by using frame-supported beam for conversion. The sectional size of the tower is 35 m x 35 m, the auxiliary building is of frame structure and is connected with the twin towers. The strength level of concrete is as follows: C55 - C40 for shearing wall, C55 for frame-supported beam, C55 - C40 for frame column, C45 - C30 for framed beam and roof boarding. The foundation is of plate-type raft type.

The sectional sizes of the structures: 1300 m x 1300 m to 900 mm x 900 mm frame column, 800 mm x 2000 mm, 800 mm x 1800 mm, 700 mm x 1500 mm for frame-supported beam. Thickness of the shearing wall: 250 ~ 450 mm for bottom tube and flooring wall, 300 ~ 200 mm for upper shearing wall.

There is sharing space between the skirt building and the twin-tower building with big hole on floor. Three-dimensional calculation software SATWE, programmed by China Academy of Architecture, has been applied for structure analysis in consideration of the elastic deformation in floor level. Since the Project is in an area of level 7 on earthquake protective standard, torsional coupling action has been taken into consideration into the calculation of seismic actions. The calculated result is 3.02s for the first self-vibration cycle and 1/1078 for the maximum displacement between floors under the Y direction seismic action.

Except for rafting foundation, 20MnSiV III steel bars produced by Pangang have been used for frame supports, the main building and the auxiliary building. For extremely important components such as frame-supported columns and frame-supported beams, cold-rolled straight threaded mechanical connector has been used for connection between steel bars for assurance of reliable loading and sufficient ductility. Electroslag welding has been adopted on the connectors used for connection between longitudinal steel bars in the invisible
columns of the shearing wall.

Based on the stipulations in Norms for Concrete Structure Engineering GBJ10 – 89 (1996 revision), the following Indexes for the engineering of steel bars are used for this Project: Standard strength: 400 N/mm²; Tensile and pressing strength: 360 N/mm²; Elastic modular: $2.0 \times 10^5$ N/mm².

Steel bars of III grade has high-strength, good ductility and weldability and is beneficial to the improvement in earthquake resistance and ductility of the steel concrete structures in the earthquake area. Meanwhile, using III grade steel bars can reduce consumption of material. This project has demonstrated that, by using III grade steel bars in the main structure, the consumption in the longitudinal direction has been 3% – 12% less than that of II grade steel bars (tensile and pressing strength is 310 N/mm²), but for the consumption of material in the columns, very small amount could be saved except the part directly supporting the frame beams and the part using in the top floor of the skirt building.

By sampling from the III grade steel bars used in the cold-rolled straight threaded mechanical connector, the tensile test has shown that the process of rib-peeling can reduce the stress concentration on cold-rolled straight threaded mechanical connector and improve the ductility.

For the engineering of frame structures with an earthquake-resistant level 1 and 2 in accordance with Norms for Concrete structure Engineering GBJ10 – 89, the stipulations on the following ratios should be reached: the ratio between the measured tensile strength and measured yield strength should not be less than 1.25, which ensures enough turning force and energy consumption power on the component at time of local plasticity; the ratio between the yield strength and the standard value should not be higher than 1.25 for Level 1 steel bar, and not higher than 1.4 for Level 2 steel bar (Note: The ratio between the measured yield strength and the standard value should not be higher than 1.25 for Level 1 and Level 2 earthquake-resistant steel bars has been revised to not higher than 1.3 in Norms for Concrete Structure Engineering GB50010 – 2002), which ensures a situation of stronger columns, weaker beams, and stronger shearing, weaker bending in case of earthquake to comply with the engineering standard of no loss in low – leveled earthquake, repairable in medium – leveled earthquake and no collapse in high – leveled earthquake. These stipulations are compulsory articles in the state-published standards for engineering, which the material of III grade steel bar used must be in comply with.

There are huge demands for III grade steel bars with diameter of 10 mm, 8 mm, 6 mm for application in floors and shearing walls, however there are no suppliers can be proposed at present for meeting these demands.