Concrete-filled steel tubular (CFST) columns have the characteristics of high bearing capacity, good plasticity and seismic performance, simple construction and convenient prefabrication. In recent years, U-shaped steel-concrete composite (USCC) beams are also favored by researchers because of their plentiful excellent properties. However, the research on the CFST joints using USCC beams is still in the initial stage. To ensure the reliability of force transmission, it is usually necessary to set interior diaphragms at the joint of CFST column to beam. However, when the column section is small, the construction of interior diaphragms is difficult, and its weld quality is difficult to guarantee. Internal welding can be avoided by using the joint form of through inner diaphragm or external diaphragm, but the welding work of through inner diaphragm is large, and may affect the indoor appearance. The size of external diaphragm is generally larger, and there are more consumables. Meanwhile, the external diaphragm may not only affect the use of the building, but also may bring inconvenience to the installation of assembled parts. In order to avoid the problems that might exist in the traditional joint forms, the joint forms can be optimized by using T-shaped interior diaphragms joints for composite columns with a certain range of sectional sizes, which has the advantages of simple structure, wide application range, convenient processing and high industrial production, thus improving the processing efficiency and bringing economic benefits. In this paper, experimental research and theoretical analysis are carried out on the shear behavior of the core area of this kind of joint, and the main results are as follows:

① Four square CFST column to USCC beam joints with T-shaped interior diaphragms were studied by pseudo-static tests, of which the parameters were the configuration of the diaphragm, the connection mode between negative reinforcement on beam top and column flange and the axial compression ratio. The failure modes of each specimen were investigated. And the load-displacement curves, ultimate bearing capacity including feature points, ductility and energy dissipation, strength and stiffness degradation, shear force-shear deformation relationship at the joint core area, horizontal displacement composition at the top of the column, joint stiffness and stress and strain distribution were analyzed. The results show that the ductility and energy dissipation performance of the joints are better than those of ordinary reinforced-concrete joints. When the axial compression ratio is increased, the stiffness and shear capacity of the joints with double T-shaped interior diaphragms connected can be slightly improved, but the strength degradation can be accelerated. It can also effectively slow down the development of concrete cracks, but it will lead to the failure time in advance and reduce the accumulated energy consumption. Unexpectedly, welding vertical stiffening plate on the interior diaphragm will adversely affect the shear resistance and energy dissipation performance of the joint.

② The ABAQUS was used to carry out fine modeling for four joint specimens. The load-displacement hysteretic curves, skeleton curves, characteristic points and the failure mode were compared with the test, and the stress and strain of steel tube and concrete as well as the distribution law of horizontal shear force in the joint core area were analyzed. A simplified finite element model for joint parameter analysis was established and verified. Six parameters, such as the concrete strength, the column web yield strength, the column web width-thickness ratio, the axial compression ratio, the height-width ratio of the core area and the stiffening plate height, were selected to analyze the shear capacity of the core area for the two kinds of joints. It provides the basis for the establishment of practical calculation method of shear capacity of the core area.

③ On the basis of the experimental study, combined with the results of finite element simulation and parameter analysis, the calculation method of shear capacity of the core area for the joints studied in this paper was proposed, considering the contributions of the column web and the core compression strut. The column web part is calculated according to the yield of the whole section under the combined stress state of shear and compress, which reflects the adverse effect of axial compression ratio. In the concrete part, the adverse effect of concrete strength on the width of the compression strut is considered, and the effect is considered by reducing the strength of the compression strut according to the results of parameter analysis. In addition, the strengthening effect of the increase of column axial compression ratio on the shear strength of the core area concrete is also considered. The test and finite element simulation values of shear capacity are compared with the calculated values of the formula, and the formula is found to be of good accuracy and applicability.