Abstract : the fire resistance of Tubular T-joint with initial damage under post-earthquake fire is investigated, the validity of the finite element mode of the Tubular T-joint is verified by the existing experimental results of hysteretic behavior and the fire experiment results for the Tubular T-joint. The parametric study of the Tubular T-joint is conducted by using the finite element software ANSYS. The 27 specimens of the Tubular T-joint are selected for parameter analysis, the 27 samples are divided into the diameter ratio (β), the wall thickness ratio (τ) and the diameter-thickness ratio (γ). Then the temperature displacement response, the failure mod and the critical temperature on parameters (β、τ、γ) are analysed and studied. The results show that the parameters (β、τ、γ) have no significant effect on the critical temperature of the tubular T-joints in the condition of the moderate or high damage levels, and that the deformation of the tubular T-joint with initial damage before fire and the failure mode of the tubular T-joints after fire are about the same.

SEISMIC PERFORMANCE OF PRECAST CONCRETE BEAM-COLUMN JOINT WITH POST-CAST CONNECTIONS

Feng Xiong
Professor, College of Architecture & Environment, Sichuan University, China
fxiong@scu.edu.cn

Bo Feng
PHD student, College of Architecture & Environment, Sichuan University, China
bo_feng91@yahoo.com

Keywords: precast concrete structure; seismic performance; post-cast connection; beam-column joint; connection location

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The connections of precast concrete beam-column joint have an important influence on the seismic performance for a frame structure. The post-cast connection, which combines the precast components with post-cast in-situ concrete when erecting, was commonly used due to the strong integrity and good seismic performance. The post-cast connection region is usually located at the beam-column joint core area in current practice. However, the connection performance may be vulnerable due to the complex stress status in joint core area when earthquakes occur. Moreover, this connection destroys the continuity of column at the joint core, which is important to form the mechanism of "strong column-weak beam". Meanwhile reinforcement congestion in the joint core area always improves the construction difficulty when erecting the precast frames. Therefore some scholars have tried to move the connection out from the joint area to the beam end and let the joint area precast with the column in factory, as the figure 1(b). But there was still a problem for this kind of connection. The connection region at the beam end is just in the place of plastic hinge and might disturb the energy dissipation mechanism or capacity. In order to avoid the problem, the connection was also arranged at mid-span of a beam sometimes. However, it will result in large-dimension, cross-shape precast components, and increase the transportation difficulties.

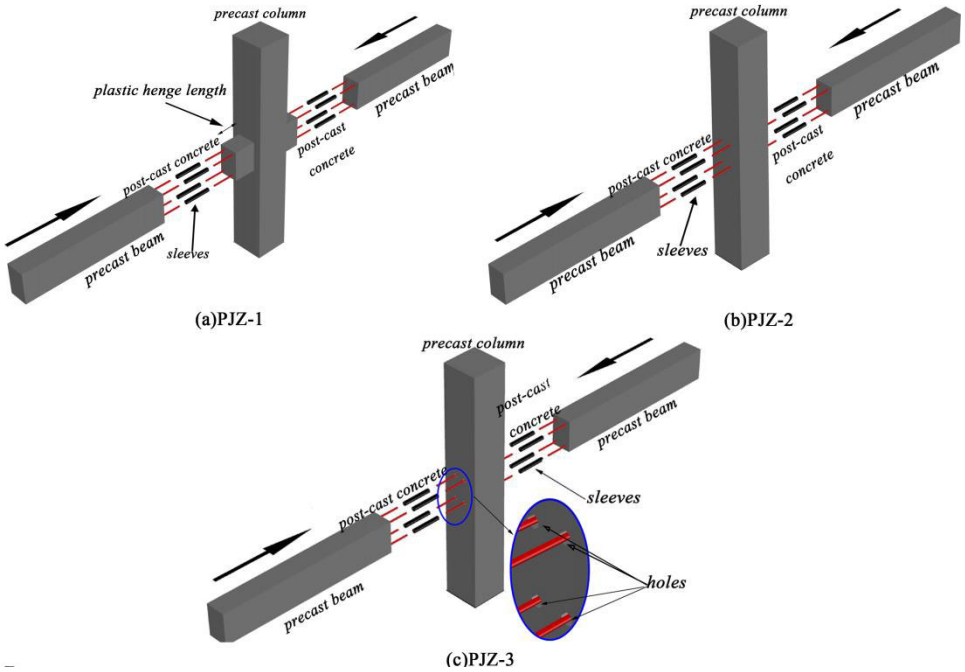

Figure 1 Schematic Diagrams of the Precast Joints

Thus, in order to balance the conflicts on transportation, construction and seismic performance, a new connecting location just outside the plastic hinge length, as the Figure 1(a) was proposed in this paper. In order to investigate the seismic performance of the joint as stated, a comparative test was conducted on three precast joints as shown in figure 1. Specimen PJZ-1 and PJZ-2 have different connection locations, and the specimen PJZ-3 is an improvement to PJZ-2, whose longitudinal rebar was not fix inside the precast column and passed through the preserved holes to be fix by grout after erecting column. A monolithic joint specimen RJZ was tested too as a baseline.

The results show that the specimen PJZ-1 displayed a similar failure mode with the monolithic specimen RJZ. However, Specimen PJZ-2 and PJZ-3 show more serious damage in the concrete, and larger strain in the rebar at the beam ends. This could be due to a great rigid rotation occurred on the beam. It was observed that the interface at beam end opened to form an obvious gap, which allowed a rotation for beam as a rigid. The great rotation deformation caused the serious concrete damage at the corner of beam. This phenomenon was found both in specimens PJZ-2 and PJZ-3, but not in PJZ-1. It was also proven by the reduction of bearing capacity with10.2% and 1.7% in specimenPJZ-2 and PJZ-3 respectively. While the bearing capacity of specimen PJZ-1 was about 8% higher than monolithic specimen RJZ. The hysteretic curves of four specimens were shown in figure 2. The specimen PJZ-1 displayed a fuller shape than specimens PJZ-2 and PJZ-3. In case of specimen PJZ-2, it was observed that the stiffness had a rapid degradation at last cycle loading, with 30.3% reduction of the relative energy dissipation ratio. It was regarded because of the great gap opening at the beam ending. In case of specimen PJZ-3, a pinching was displayed in the hysteretic curve. And its relative energy dissipation ratio was the lowest among all specimens. It was due to poor bonding between the concrete and rebar grouted.

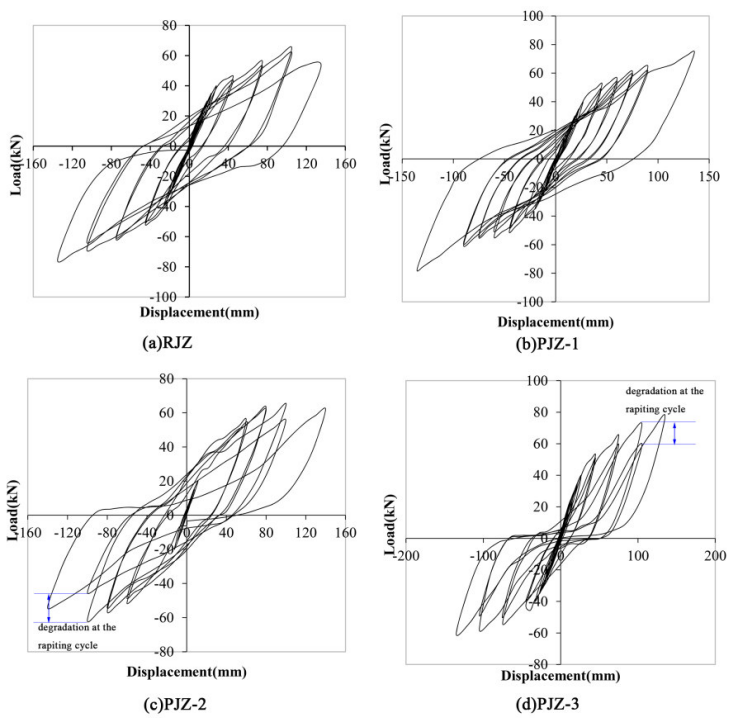

Figure 2 Hysteretic Curves

Based on the test results, it can be concluded that the post-cast joints at beam ends have similar performance with the monolithic joint. Thus, it can be designed as the monolithic joint. When the connection locates at the beam end like PJZ-2, a big gap opening could occur at the interface and result in a serious concrete damage at the beam ends and a little reduction of the bearing capacity. Moreover, the configuration like PJZ-3 with moveable longitudinal rebars could cause rebars slipping along reserved holes and decrease energy dissipation. Therefore through comparing, the connection located out of the plastic hinge proposed in this paper, like specimen PJZ-1, displays more satisfactory performances. It is suggested to apply in the future.

A TWO-STEP UNCONDITIONALLY STABLE EXPLICIT INTEGRATION ALGORITHM FOR VIBRATION ANALYSIS OF STRUCTURES

Li Chang qing
Lecturer , Central South University, China,
lcq_stu@126.com

Jiang Li zhong
Professor, Central South University, China,
lzhjiang@csu.edu.cn

T. Y. Yang
Associate Professor，the University of British Columbia, Canada
yang@civil.ubc.ca

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Time history analysis is becoming the routine process to quantify the response of the structure under dynamic loads. In this paper, a novel two-step unconditionally stable explicit integration algorithm, named Unconditional Stable Two-Step Explicit Displacement Method (USTEDM), is proposed for vibration analysis of structure. USTEDM is unconditionally stable, requires low memory, produces no overshoot, and is third order accurate. he accuracy and efficiency of USTEDM are presented and compared with other commonly used integration algorithms. The result shows that the proposed algorithm has superior performance and can be used efficiently in solving vibration response of civil engineering structure.

SEISMIC PERFORMANCE OF FARMER SINGLE-FAMILY HOUSE IN WEST CHINA DURING THE RECENT EARTHQUAKES

BIXIONG LI
Professor, Sichuan University, China
libix@126.com

Keywords: seismic performance; earthquake; west China; single-family house; rural areas

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Single-Family Houses (SFHs) in rural areas of China were prone to be attacked during the earthquake, many SFHs suffered moderate to severe damages even being subjected to small or medium earthquake, and collapse usually happened to SFHs once medium or large earthquake took place.

The western region of China is underdeveloped, e.g. Sichuan province, Yunnan province, Qinghai province, Tibet, Xinjiang, and Gansu province, where earthquakes happened frequently. Various minorities live in these areas, and the SFH style is different from one minority group to the other due to special geographic location and climatic condition. Figure 1-4 show several typical residential architectures in Western China. These residential architectures with historical content make up of the regional feature of these regions. Several local raw materials, such as stone, timber, and brick made from clay or concrete, are chosen to act as the building structure materials. Almost all SFHs in these regions were built by experience and there were no codes or standards to follow.

(a) Plank infills; (b) Brick infills

Figure 1 Timber structure with clay tile roofing

Figure 2 Masonry structure with timber-tile roofing

(a) Timber roofing; (b) Rammed earth roofing

Figure 3 Timber structure with unreinforced masonry or earth enclosure wall

Figure 4 Watch tower made of stone

The general seismicity of Western China area was overviewed. In the recent 10 years, a series of medium to large earthquakes sequentially happened in the west areas of China. There were M8.0 Wenchuan earthquake, 2008; M6.1 Panzhihua earthquake, 2008; M7.0 Yushu Earthquake, 2010; M7.0 Lushan Earthquake, 2013; M6.7 Minxian Earthquake, 2013; M6.5 Ludian Earthquake, 2014; and M6.3 Kangding Earthquake, 2014. Poor seismic performances of these SFHs were usually observed after even one medium earthquake.

A lot of field reconnaissance were carried out to study the damaged and undamaged SFHs affected by each earthquake. The various practices of buildings seismic design and construction in this region were investigated. Many structural deficiencies and mistakes such as nonductile details, poor masonry quality, large and heavy overhangs, unconfined walls or gable walls and tall slender towers were observed. To sum up, thousands of existing structures constructed nonductile are present in seismically active regions in Western China, and many lives will be needlessly lost in future strong earthquakes unless these buildings are retrofitted.

S-FRAME SOFTWARE IN ACADEMIA

Marinos Stylianou
CEO, Ph.D, S-FRAME Software, Inc., USA
marinoss@s-frame.com

Keywords: Structural Engineering, Structural Software, Structural Education

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Will provide an overview of the research projects currently under way by S-FRAME Software in collaboration with several Canadian Universities and will also discuss how our various software products are used to complement teaching of undergraduate structural engineering courses.