A Study on Traditional Chinese Wood Joint Differences as a Supplement for Wood Structure Code

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Abstract China is famous for its ancient wood structures. These venerable buildings need constant repair although there are few specific guidelines. The current principles of wood structure fail to explain cases like earthquake, which require studies on traditional wood joints. The present study is based on experiments carried out on 13 different wood joints. The properties of joints and differences were expected and studied. Behaviors of traditional Chinese wood structures were concluded. Some guidelines were summarized. The energy absorbing ability and frame stiffness studies may suggest further research projects. Taking all these into consideration, the present study aims to be an important supplement of current Chinese wood structure code, and it may be relevant to the study of wood structure safety worldwide.

Keywords Chinese wood structures, joint properties, wood principles,

1. INTRODUCTION

China is famous for ancient wood buildings while there are still few useful guidelines now. Current wood structure code may lead to unknown deviations because it is based on the wood truss which had not been used in past. Many studies tried to use the concept of "half rigid" to explain the behavior of mortise and tenon joints and helped in structural studies. However, since only the Wedged form of all joint was the basis of such tests, to apply the results widely without first verifying may abet unpredictable errors.

This study aims to expand the current study of mortise and tenon joints through experimenting with 13 different joint test pieces. A better understanding of joint behavior and a more accurate joint model are expected. These results might be helpful for wood structure safety worldwide.

This study can be divided into 3 steps: (1) Researching joint properties with experiment. (2)Building joint models based on the former data. (3)Initiating structural analysis based on the joint model.

2. PLAN OF EXPERIMENT

2.1. Joints and specimen

Five joints showed in Figure 1 were selected. Thirteen Each joint has several sizes. So there are five groups which are named from KJ1 to KJ5. Frames connected with five group joints were designed then loaded with horizontal forces to acquire joint half rigid data.

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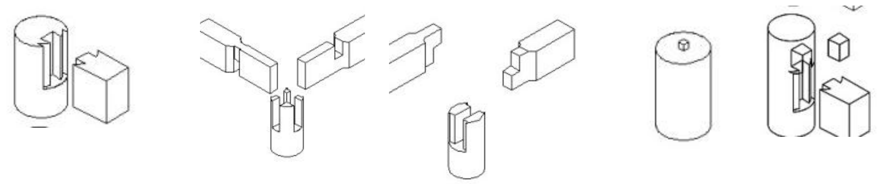


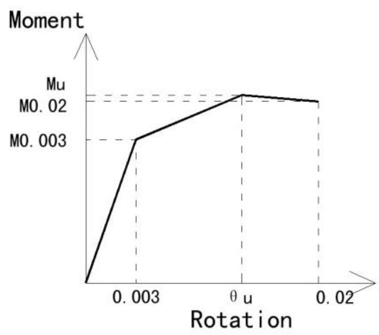
Wedged(yanwei) Cross Corner Half Penetrate Bread Sink Wedged

Figure 1

2.2. Results

A joint model was built based on experimental data. KJ1 to KJ5 refer to different groups. K1 is the stiffness at rotation 0.003, which is assumed to be elastic. K2 is the stiffness after K1 until the ultimate peak. K0.02 is the mean stiffness at angle 0.02.

Table 1– Joint Stiffness

		Stiffness(KnM/rad)					
Stiffness		K1	K2	K0.01	K0.02	Ultimate moment(KnM)	**Joint model**
Wedged	KJ1-1	226	13	105	60	1.1	
	KJ1-2	400	36	145	75	1.5	
	KJ1-3	103	31	72	37	0.7	
	KJ5	230	15	110	65	1.1	
Cross Corner	KJ2-1	236	7	82	36	0.75	
	KJ2-2	353	22	120	64	1	
	KJ2-3	280	97	74	29	0.8	
Half Penetrated	KJ3-1	150	26	70	45	0.9	
	KJ3-2	480	16	152	69	1.6	
	KJ3-3	147	25	73	33	0.75	
Bread	KJ4-1	150	40	121	54	0.9	
	KJ4-2	327	38	121	64	1.2	
	KJ4-3	114	27	83	40	1.2	

3. CONCLUSION

Based on above studies, there are some important conclusions that should be highlighted.
Firstly, each kind of joint studied has a unique half-rigid property which was concluded in Table 1.
Secondly, some studies such as energy absorbing ability and p-delta effect on wood frames were discussed. Earthquake-resisting abilities of some traditional Chinese wood structures are calculated and compared. It helps to prove that some ancient regional architectural design patterns are helpful for resisting earthquakes.

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