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**Autor:** Izumi, Mitsuaki / Yamadera, Noriaki  
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## Behavior of Steel Reinforced Concrete Members under Torsion and Bending Fatigue

Comportement d'éléments en béton armé soumis à la fatigue par torsion et flexion

Verhalten von Stahlbetonelementen unter Torsions- und Biegungsermüdung

**Mitsuaki IZUMI**

Prof. Dr.  
Meijo Univ.  
Nagoya, Japan

**Noriaki YAMADERA**

Dir.  
Tokyo Expr. Public Corp.  
Tokyo, Japan

In spite of frequent use of Steel Reinforced Concrete (SRC) for structures, the behavior of SRC members under torsion and bending fatigue has not yet been clarified.

The authors carried out research on SRC and RC members under torsion and bending fatigue with the following results:

### 1. RESEARCH ON TORSION

Test specimens and the torsional loading are shown in Fig-1 and test results are shown in Table-1.

#### Conclusions

- 1) The behavior of SRC and RC members subjected to torsion is very different in pre- and post cracking. The cracking moment is approximately equal to the failure moment of the corresponding plain concrete member by the equation based on elastic theory and by the cumulative calculation method.
- 2) In post-cracking, the behavior of SRC and RC members is completely different from that predicted by elastic theory, and the strain of reinforcement and steel joists suddenly increases.
- 3) The ultimate torsional strength of SRC members may be approximately estimated by the equation based on space truss theory and by the cumulative calculation method.

### 2. RESEARCH ON BENDING FATIGUE

Test specimens and the loading set-up are shown in Fig-2. The test was carried out with repeat loading 200/min, steel stresses from 2000-2400kg/cm<sup>2</sup> to 300 kg/cm<sup>2</sup>.

Test results of fatigue strength of members is shown in Fig-3.

#### Conclusions

- 1) The failure of SRC members occurred due to the fatigue of steel joists; thus the fatigue strength of steel joists is weaker than that of reinforcements, as shown in Fig-3.
- 2) The ultimate limit in alternating fatigue stress is 1100kg/cm<sup>2</sup> for reinforcement bars, and 1020kg/cm<sup>2</sup> for steel joists.
- 3) Concerning the number and width of cracks, there is little difference between RC and SRC members.

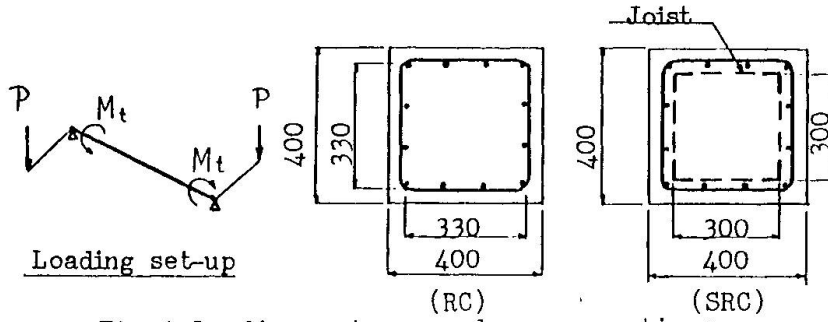


Fig-1 Loading set-up and cross-sections

Table-1 Test results and comparison between test results and calculations

Specimen	steel (%)	Test		Calculation		Test/Calc'		Remarks
		Cracking moment	Ultimate Moment	Cracking Moment	Ultimate moment	Crack-ing	Ultimate	
I(SRC)	1.92	4.00	12.5	3.55	12.3	1.13	1.02	The compressive strength of concrete is 270-390 kg/cm <sup>2</sup> . The Yield strength of steel bars and joists are 2500kg/cm <sup>2</sup> .
J(SRC)	2.41	4.00	13.0	3.59	14.4	1.11	0.90	
K(SRC)	4.18	4.00	21.8	3.50	21.4	1.14	1.02	
L(RC)	1.00	5.00	7.3	4.50	6.60	1.11	1.10	

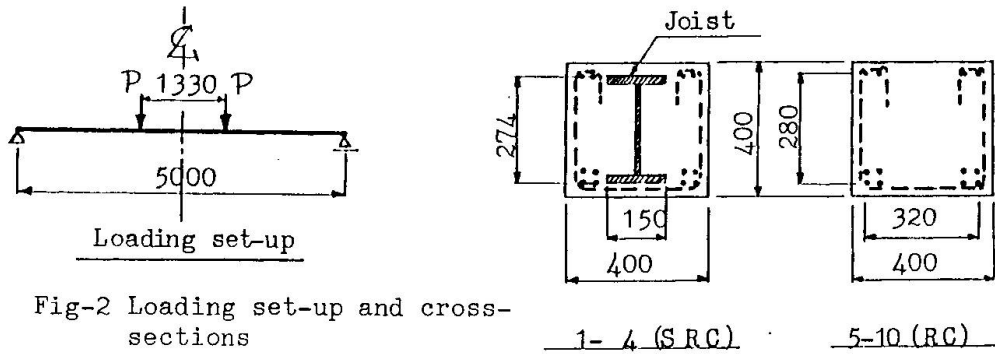


Fig-2 Loading set-up and cross-sections

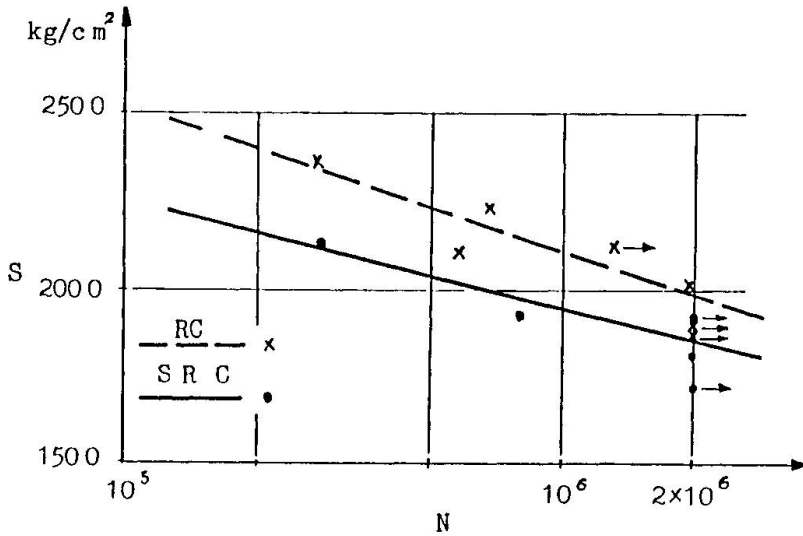


Fig-3 S-N Curve