

# SM490A 가 Fatigue Characteristic of SM490A Welded Joints for Bogie Frame

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J. S. Park, C. S. Seok, J. M. Koo, D. J. Kim, J. H. Shin and B. C. Goo

## ABSTRACT

In this study, we compared the fatigue characteristics of weld metal with those of base metal. Also we examined the influence of heat treatment and weld bead profiles for the fatigue life of weld metals. From the experimental results, it was seen that the fatigue characteristics of welded specimens with a grinded toe of bead are slightly better than those are not grinded. Also the fatigue life is affected more by the stress concentration on the profile change in the weld toe rather than by residual stress influence, because the fatigue characteristic of weld metals was not influenced whether the heat treatment is conducted or not.

### 1.

가 , 가 가 가 ,  
가 가  
(1)  
200  
가 가  
가  
SM 490A 가  
가 가

\*  
\*\*  
\*\*\*

2.

2.1

가 SM490A Steel , Table 1 SM490A steel  
 . 3 Pass GMAW (Gas Metal Arc Welding)

Table 2

Table 2

590 1 가  
 120 .

2.2

ASTM E8<sup>(2)</sup>

ASTM E466<sup>(3)</sup>

Fig. 1

. Fig. 1(a)

가

CO<sub>2</sub> 가

가

GMAW

? 가

. Fig.

1(b)

가 320mm

50ton(Instron model 8503) 25ton

(Instron

model 8802)

Fig. 2

2.3

SM490A

ASTM E8<sup>(2)</sup>

1mm/min

가 25 mm

Table 1 Chemical compositions of SM490A steel (wt.%)

C	Si	Mn	P	S	Fe
~0.20	~0.55	~1.60	~0.035	~0.035	Bal.

Table 2 Welding and heat treatment conditions

	Specification			
Welding method	GMAW (Gas Metal Arc Welding)			
Welding conditions	Semi-auto ROBOT			
	1 Pass			
	2 Pass			
	3 Pass			
	Current (A)	150	190	180
	Voltage (V)	103	105	105
	Speed (cm/min)	29	18	18
Wire size	Diameter 1.2 mm			
Welded material	Filler metal spec. : A5.18 Classification : AWS ER 70S-6			
Shielding gas	CO <sub>2</sub> or Ar(85%)+CO <sub>2</sub> (15%) Flow rate : 15-20 l/min			
Direction	Backhand			
Heat treatment conditions	Holding temperature : 590±20℃ Holding time : 1 Hour Heating and Cooling rate : 120℃ Maximum temperature : 200℃			

ASTM E8<sup>(2)</sup>

0.2%

SM490A steel

(load-displacement)

3

Table 3

2.4

ASTM E466<sup>(3)</sup>

(Instron model

8802, 25ton)

PC

2×10<sup>6</sup> cycle

3.

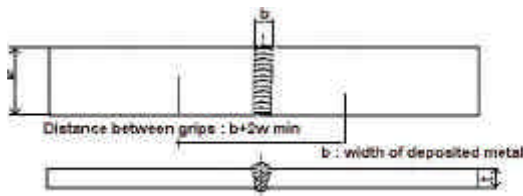
3.1

Fig. 3

Fig. 3

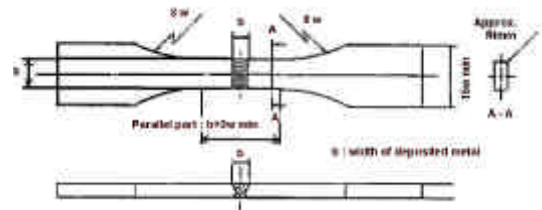
(4)

Fig. 3



t = 10 mm, w = 25 mm, l = 200 mm

(a) Fatigue test specimen without cut-off bead



t = 10 mm, w = 25 mm, l = 320 mm

(b) Fatigue test specimen cut-off bead

Fig. 1 Fatigue test specimen



Fig. 2 Universal test machine

Table 3 Tensile test results of the SM490A steel

Specimen	Base metal-1	Base metal-2	Base metal-3
Yield strength (MPa)	346	348	347
Ultimate strength (MPa)	515	522	519

가

(5)

3.2

Fig. 4

가

Fig. 5

?

가

가

Fig. 6

?

가

가

가 (6-7)

가

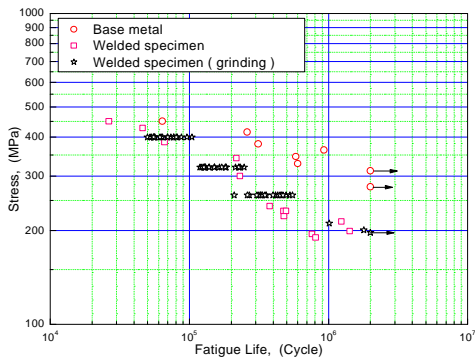


Fig. 3 Comparison between base metal and welded specimen (before heat treatment)

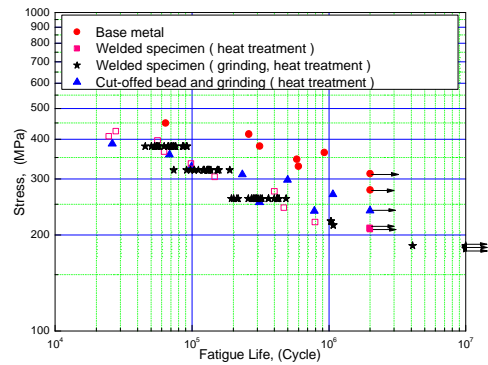


Fig. 4 Comparison between base metal and welded specimen (after heat treatment)

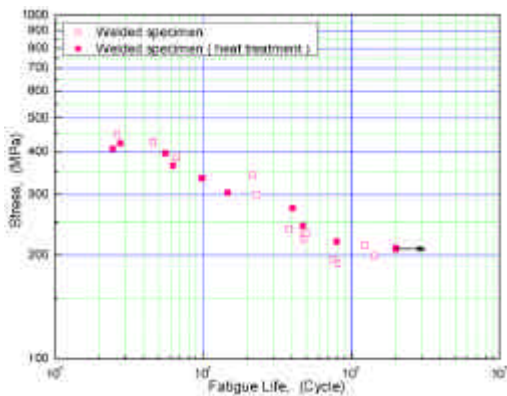


Fig. 5 Comparison of welded specimen

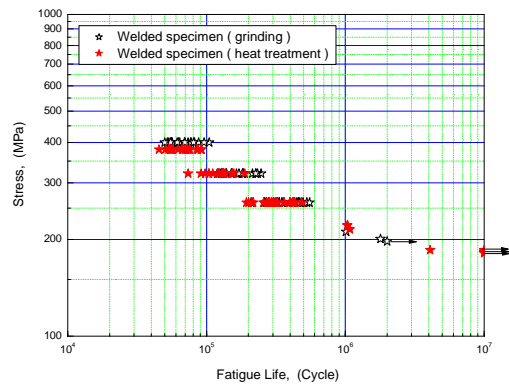


Fig. 6 Comparison of welded specimen (grinding)

Table 4 Results of  $K_t$  and bead profile data

Specimen number	Fracture position	Radius	Degree	Height	$K_t$
AAY-1	4	0.64	47.00	1.86	2.35
AAY-2	8	1.67	38.88	1.78	1.71
AAY-3	5	0.18	40.59	1.72	3.95
AAY-4	8	0.38	38.27	1.92	2.89
AAY-5	4	0.34	44.28	1.95	3.06
AAY-6	8	0.22	59.89	2.16	3.76
AAY-7	4	1.29	57.84	1.87	1.85
AAY-8	8	0.16	39.73	1.85	4.24
AAY-9	6	0.25	50.83	2.78	3.73
AAY-10	3	0.38	37.77	1.50	2.77

4.

4.1

가  
(Mitutoyo) stylus type (CV-4000 S4)  
weld toe  
Fig. 7 8  
( ), ( ), (h)

4.2

가  
(1) (1)  
Fig. 7

$$K_t = 1 + \left[ \frac{1 - \exp(-0.9\sqrt{T/h} \cdot (\pi - \theta))}{1 - \exp(-0.9\sqrt{T/h} \cdot \pi/2)} \right] \cdot \left( \frac{1}{2.8T/t - 2} \cdot \frac{h}{\rho} \right)^{0.65} \quad (1)$$

Table 4

가 가 Fig 8 5  
AAY AAY-3

가  
Fig. 9 가  
(K<sub>t</sub>)가

(4-5)

가



Fig. 7 Schematic of the specimen

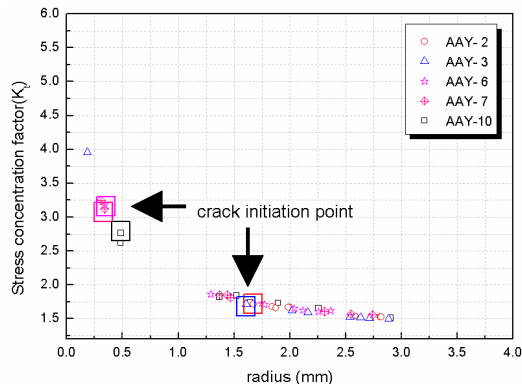


Fig. 8 Results of  $K_t$  and bead profile data



Fig. 9 Fracture surface of a welded specimen

5.

?  
 가  
 (1) ?  
 가  
 (2) (K<sub>t</sub>)가  
 SM490A 3가  
 가  
 가  
 가  
 2003 BK21 가 (SAFE) 가 (NRL) ( ) 가

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