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# Numerical Analysis for Residual Stress Relaxation of Weld Zone

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**Key Words:** Welding( ), Weld Zone( ), Residual Stress( ), Residual Stress Relaxation( )

## Abstract

The problem of welding stresses and fatigue behavior is the main concerns of welding research fields. The residual stresses and distortion of structures by welding is exert negative effect on the safety of mechanical structures. That is, expansion of material by high temperature and distortion by cooling during welding process is caused of tensile and compressive residual stresses on welding material, and this residual stresses reduce fracture and fatigue strength of welding structures. The accurate prediction of residual stress and relaxation due to loading and post weld heat treatment of weld zone is very important to improve the quality of weldment. In this study, a finite element modeling technique is developed to simulate the relaxation of residual stresses due to loading and post weld heat treatment of weld zone. The accuracy of finite element models is evaluated based on experimental results and the results of the analytical solution.

### 기호설명

: , [kg/mm<sup>3</sup>]

K : , [J/s mm ]

C<sub>p</sub> : , [J/kg ]

σ<sub>y</sub> : , [Mpa]

E : , [Gpa]

1.

가

가

가 ,

가

†

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'ABAQUS'

2.  
2.1

Fig. 1

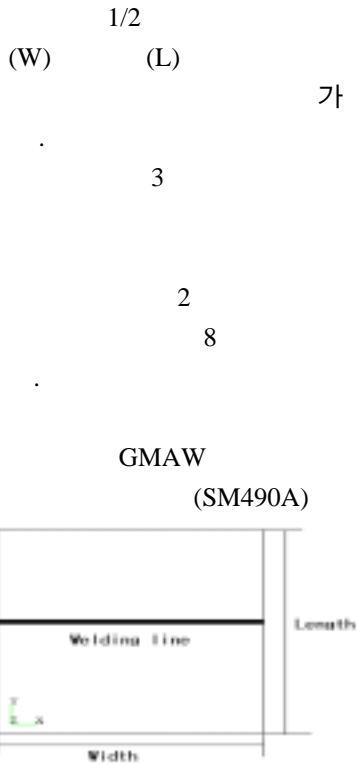


Fig 1 Model for 2D heat flow analysis

2.2

(element birth)

(distributed

heat flux)

(latent heat)

Fig. 2

20

Fig. 3

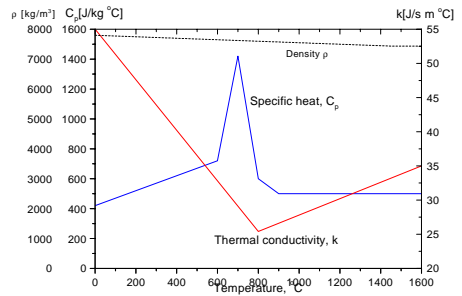


Fig. 2. Material properties for heat transfer analysis

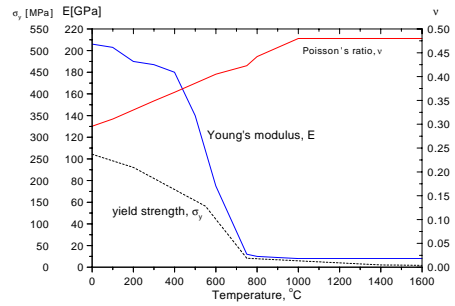


Fig. 3. Material Properties for thermal stress analysis

y

x

2.3

Fig. 4

4, 10, 14, 20

Fig. 5

( xx)

(yy) Fig. 6

(2)

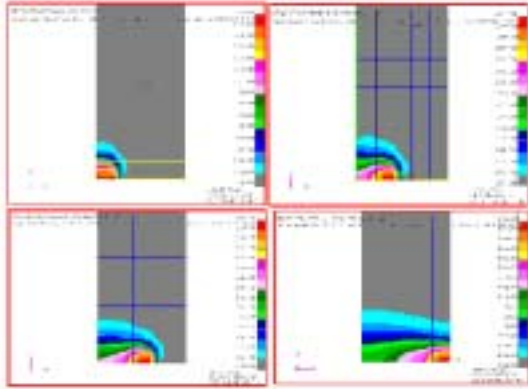


Fig. 4 Temperature change in welding process

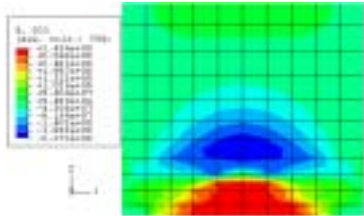


Fig. 5 Residual stress distribution(xx)

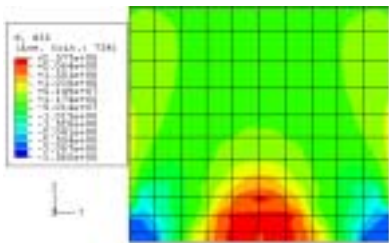


Fig. 6 Residual stress distribution(yy)

Fig. 7, 8

Fig. 7

x

Fig. 9

30%, 60%, 90%

가

x-

320MPa

가 가 25mm

180Mpa

가

가 가

가

Fig. 8 y

Fig. 10 y-

가 25mm

320Mpa

가

가

가

가

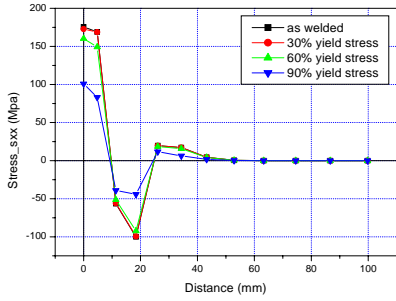


Fig. 9 residual stress relaxation(xx)

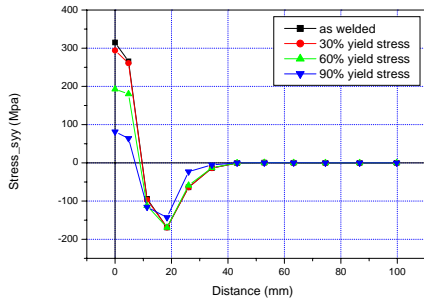


Fig. 10 residual stress relaxation(yy)



Fig. 11 FE model

3.2

Fig. 12 - 14

Fig. 12

20, 21

2, 3

가

Fig. 15

3.

3.1

10mm

220

가

20mm

135 , 30mm

100

가

1000 × 600 mm

3pass

10, 20, 30mm

K-type

2

4859

가

1432

3pass

Fig. 16 a)

Fig. 16 b)

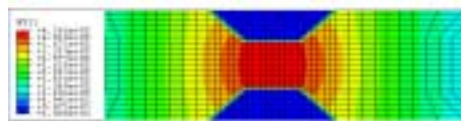


Fig. 12 Temperature distribution during 1st welding

가

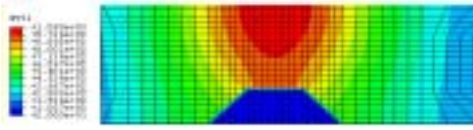


Fig. 13 Temperature distribution during 2nd welding

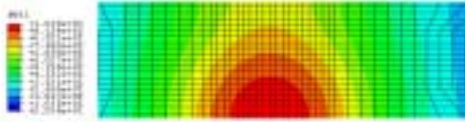


Fig. 14 Temperature distribution during 3rd welding

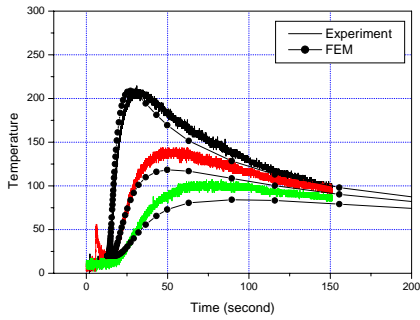


Fig. 15 Temperature change during 1 pass



a) Experiment



b) FEM

Fig. 16 Deformation after welding

3.3

40mm

가

가 10mm

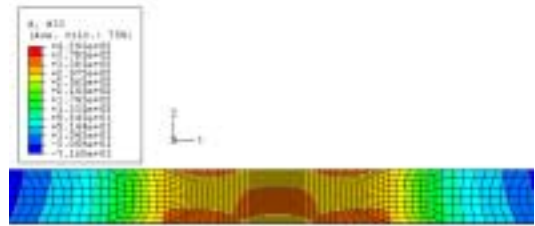


Fig. 17 Distribution of transverse stress

3.4

Hole-drilling method

ASTM E837

Fig. 18

가

5mm 25mm, 55mm

Fig. 19

40mm

5mm

가 350 Mpa

가

110Mpa

25mm

95Mpa, 55 mm

-50 Mpa

Fig. 20

100Mpa



Fig. 18 Strain gage and hole drilling instrument

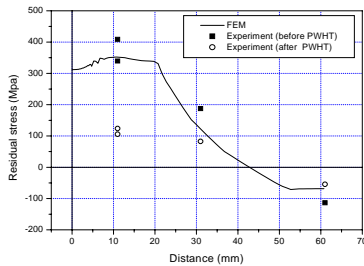


Fig. 19 longitudinal residual stress distribution

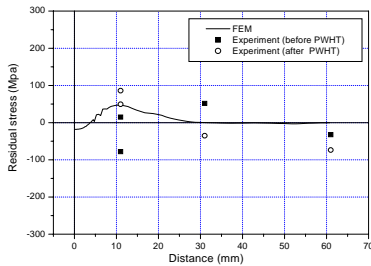


Fig. 20 transverse residual stress distribution

4.

GTMA

(1) GTMA

2

(2)

(3)

350 Mpa

110 Mpa

가

(NRL)

(1) , 1997,

15 , 1 , pp.15 ~ 25

(2) , 1995,

GMAW

(3) , 1996,

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