Adhesive Strength Evaluation of Coating Layer by Modified Pin Test

—Applicability of Stress Singularity Parameter for Evaluating Adhesive Strength of Coating Film (Phase 2)—

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To establish the adhesive strength evaluation method of thin coating layer with high adhesive strength, hard chrominum plating and ($Al_2O_3+TiO_2$) spray coating were tested by newly proposed pin test method and their date were evaluated by stress singularity parameter (κ_{cr}).

Key Words: Hard chrominum plate, $Al_2O_3+TiO_2$ sprayed coat, Adhesive Strengh, Stress singularity parameter (κ_{cr}).

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Study of $\mathcal{G}$ value of Edge Crack Existing along Bond Line of Joint Composed of Dissimilar Materials

—Study of Specimen Size for Estimating Joint Strength of Dissimilar Materials (Part 2)—

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The energy release rate, $\mathcal{G}$, used for estimating the joint strength of dissimilar material joints with defect has been investigated by means of a boundary element method (BEM). Size and material parameters of $\mathcal{G}$ value in both load and residual stress fields were derived. The main conclusions are as follows:

1) In a thermal stress filed, the relation between $\mathcal{G}$ value and material properties is given by the following equation;

For the case of Poisson's ratios of dissimilar materials being equal,

$\mathcal{G}/E^A\{(\alpha^A-\alpha^B)\ T\}^2a=f(E^B/E^A,\ \nu^A=\nu^B)$

where E is Young's modulus. ν is Poissons' ratio. α is a coefficientof linear expansion.

T is temperature difference. a is half length of crack.

Suffix A and B mean materials A and B.

For the case of ν^A being different from ν^B,

$\mathcal{G}/E^A(\alpha^A T)^2a=g\,(E^B/E^A,\ \nu^A,\ \nu^B,\ \alpha^B/\alpha^A)$

2) When the height of specimen, h, is greater than the width of specimen, b, h, hardly affects $\mathcal{G}$ value in both load and residual stress fields.

3) When b is greater than twice of h, $\mathcal{G}$ value is almost constant in both fields.

Key Words: Edge crack; Energy release rate; Dissimilar joint; Size effect; Boundary element method

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Root Failure Resulting from Toe Treatment of Non-Load-Carrying Cruciform Fillet Welded Joints

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The smoothing of fillet toe results in improvement of fatigue strength, but at the same time it seems to develop a liability to root failure occurrence.

The purpose of this study is to investigate the relation between root failure and stress concentration in toe smoothed non-load carrying type cruciform fillet welded joint and the effects of lack of joint penetra-

tion on fatigue strength of the fillet joint.

Lack of joint penetration in the welds was deliberately introduced by a special method of putting a half cut core wire on the weld joint. After weldig, toes were TIG dressed. In fatigue tests, the maximum stress of fatigue cycle was fixed to yield stress of the material (Max. stress=Yield stress (const.)=559MPa, Min. stress=variable).

Main results obtained are summarized as follows:

1) The root failure seems to be apt to occur if the elastic stress concentration factor at the TIG dressed toe is less than about 1.6 in the present tests.

2) The difference in heights of lack of joint penetration, 0.92 mm and 1.64 mm, shows no significant effects on fatigue strength.

3) The root failure occurs in general at a lower stress range than the stress range where a toe failure follows a root crack.

4) The most important condition for preventing a root failure is to allow no lack of joint penetration (rib side) i.e. slit perpendicular to the loading direction.

Key Words: Root failure, Lack of joint penetration, Toe treatment, Improvement, Fatigue strength, Fillet welded joint, Steel

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A Judging Method of Advisability of Welding under Pulsating Loads

—Welding on Structures in Service condition (Report III)—

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The authors have been carrying out a series of research for the prevention of hot cracks produced by welding on the steel structures in service condition from a mechanical point of view. The opening displacement of root gap, $\Delta\delta$, which can be easily measured before welding, has been already proposed as the practical mechanical measure for deciding the initiation of the hot cracks.

In this study, based on $\Delta\delta$, a way which judges the advisability of welding under the pulsating loads is concretely shown with taking the bridge in service condtion an instance. Therefore, first, the various displacement, vibration and acceleration are measured at the weld joints of the bridge in the service condition. So, the wave of vibtation of $\Delta\delta$ in service condition is clarified and its amplitude and the number of oscillations are known. On the other hand, as one of powerful approach to prevention of hot cracks based on $\Delta\delta$, it is considered that the critical value, $\Delta\delta_{cr}$ which is mechanical property of the welding electrode for the hot cracks, is made as big as possible. From this point of view, the new welding electrode was tried to be developed. As the results of weld cracking test, $\Delta\delta_{cr}$ of the newly developed welding electrode could be made three or four times as big as that of commonly used welding electrodes. From this fact, the welding under the pulsating loads should be easy. In these considerations, a way based on $\Delta\delta$ which judges the advisability of welding under the pulsating loads is shown. Then, applying the judging method to the repair work on the bridges in service condition, its validity is concretely shown.

Key Words: Hot crack, Pulsating loads, Prevention of weld crack, Mechanical measure for hot crack, Welding electrode, Welding in service condition

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Nondestructive Evaluation of Residual Weld Stress and Mechanical Stress Relieving by Acoustoelasticity

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Residual stress affects the failure of machines and structures by contributing to buckling and brittle fracture when those failures occur at low applied stress levels. In addition, residual stress may contribute to fatigue and corrosion cracking. For in-process and in-service failure prediction of the machine and structure, nondestructive methods for residual stress measurement are required. The research on nondestructive evaluation of residual stress using ultrasonci technique has attracted special interest recently. A