Introduction. Adhesive bonding has been used in many engineering fields because of the reducing structure weight and bonding the different materials compared to welding and other method. Since the strength of bonded materials is changed depending on the bond line thickness, it is difficult to apply to engineering design. In this study, the strength evaluation method of bonded round bar with adhesive layer is proposed by using the stress intensity factor of the circumferential crack near the interface and the circumferential interface crack in the bonded round bar. The critical stress intensity factors of circumferential crack are calculated by using the experimental fracture stress of bonded round bar with different bond line thickness.

Analysis method and conditions. The purpose of this study is to examine the strength evaluation of adhesively bonded round bar shown in Fig.1. In Fig.1, the notations ‘a’, ‘c’, ‘h’ and ‘d’ indicate the crack depth, the distance from the interface to the crack, the adhesive layer thickness and the diameter of round bar, respectively, and the point (a,c) indicates the crack tip position.

Numerical results and discussion. In this study, the stress intensity factor of the circumferential crack near the interface in the bonded round bar with the adhesive layer shown in Fig.1(b) is analysed. Next, the dimensionless stress intensity factor defined in equation (1) are verified. In equation (1) \( \sigma_y(a,c) \) is the singular stress value at the point (a,c) in round bar without the crack as shown in Fig.1(a) calculated by FEM.

\[
F_1 = \frac{K_1}{\sigma_y(a,c)\sqrt{\pi a}}
\]  
(1)

From the results obtained by FEM, it is found that the dimensionless stress intensity factor \( F_1 \) becomes constant at \( F_1=1.12 \) regardless of the adhesive layer thickness \( h \). Therefore, \( K_1 \) of the circumferential small crack near interface can be expressed by the following equation (2).

\[
K_1 = 1.12\sigma_y(a,c)\sqrt{\pi a}
\]
(2)

Strength evaluation of bonded round bar. The strength of bonded round bar is evaluated by the stress intensity factor of the circumferential crack near the interface. Tensile tests of bonded round bar with different adhesive layer thickness are performed by Naito (1). In this study, the critical stress intensity factor \( K_{IC} \) of bonded round bar is calculated using the fracture stress \( \sigma_c \) obtained experimentally by Naito. Fig.2 shows the critical stress intensity factor \( K_{IC} \) when the adhesive layer thickness is changed. As shown in Fig.2, it is found that the critical stress intensity factor becomes constant value regardless of the adhesive layer thickness \( h \).

References.