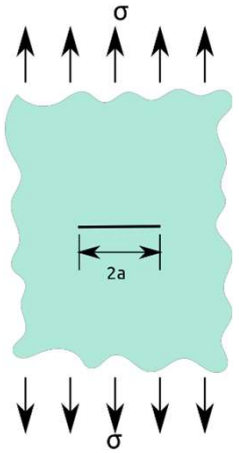
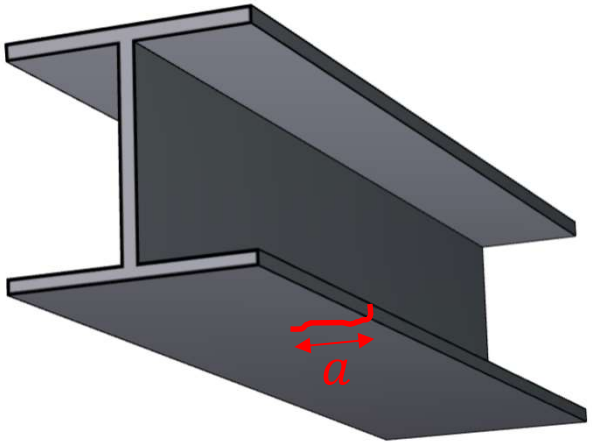
レポートの解答例
Sample Answer (6)

亀裂の長さをaとした回答と，亀裂の長さを$2a$とした回答の両方を正解とします．
Both cases considering the crack length to be a and $2a$ are treated as a correct answer.





実際の構造物に左図のような亀裂が入ったら，その長さは$2a$です．しかし，実際には，右図のように端部から亀裂が入るケースが多く，左図の半分が亀裂長さにあたり，亀裂長さはaになります．If a crack as shown in the left figure occurs in a structure, its length is $2a$. However, in real, cracks often occur from the tip of steels as shown in the right figure. In this case, the crack length is a.

レポートの解答例
Sample Answer (6)

亀裂の長さ= $2a$の場合
In the case of crack length = $2a$

シナリオ Scenario 1

パリス則によると，亀裂の長さがa_0からa_cになるまでの繰返し数は，以下の式で与えられる．According the Paris's law, number of cycles when crack length changes from a_0 to a_c is given by

$$N = \frac{1}{C(\Delta\sigma\sqrt{\pi})^m}\int_{a_0}^{a_c} a^{-m/2}da$$

$$= \frac{1}{C(\Delta\sigma\sqrt{\pi})^m}\left[\frac{2}{2-m}a^{\frac{2-m}{2}}\right]_{a_0}^{a_c}$$

$$= \frac{1}{C(\Delta\sigma\sqrt{\pi})^m}\cdot\frac{2}{2-m}\left(a_c^{\frac{2-m}{2}} - a_0^{\frac{2-m}{2}}\right) \quad \ldots(1)$$

$m = 3, C = 1.0\times10^{-12}, \Delta\sigma = 100, a_0 = 0.005m, a_c = 0.015m$

上記の値を代入して，By substituting the above values,

$$N = 2{,}148{,}479$$

レポートの解答例
Sample Answer (6)

亀裂の長さ= $2a$の場合
In the case of crack length = $2a$

シナリオ Scenario 2

まず，繰返し数が100万回の時点で，亀裂の長さがどのくらいに進展するかを求める．式(1)をa_cについて解くと，First, calculate how much length the crack propagates at the 1 million cycles. By solving eq (1) for a_c,

$$a_c = \left\{ \frac{NC(\Delta\sigma\sqrt{\pi})^m(2-m)}{2} + a_0^{\frac{2-m}{2}} \right\}^{\frac{2}{2-m}}$$

$$m = 3, C = 1.0 \times 10^{-12}, \Delta\sigma = 100, a_0 = 0.005m, N = 1{,}000{,}000$$

上記の値を代入して，By substituting the above values,

$$a_c \approx 0.0077m$$

100万回以降に関して，新たに$a_0 = 0.0077m$とし，$\Delta\sigma = 150$として式(1)を計算すると，By using newly set $a_0 = 0.0077m$ and $\Delta\sigma = 150$ in eq (1) for the period after 1 million cycles,

$$N \approx 344{,}121$$

求めたいのは繰返し数の合計値なので，Since we want to obtain total number of cycles, 1,000,000+344,121=1,344,121.

レポートの解答例
Sample Answer (6)

亀裂の長さ= aの場合
In the case of crack length = a

シナリオ Scenario 1

パリス則によると，亀裂の長さがa_0からa_cになるまでの繰返し数は，以下の式で与えられる．According the Paris's law, number of cycles when crack length changes from a_0 to a_c is given by

$$N = \frac{1}{C(\Delta\sigma\sqrt{\pi})^m}\int_{a_0}^{a_c} a^{-m/2}da$$

$$= \frac{1}{C(\Delta\sigma\sqrt{\pi})^m}\left[\frac{2}{2-m}a^{\frac{2-m}{2}}\right]_{a_0}^{a_c}$$

$$= \frac{1}{C(\Delta\sigma\sqrt{\pi})^m}\cdot\frac{2}{2-m}\left(a_c^{\frac{2-m}{2}} - a_0^{\frac{2-m}{2}}\right) \quad \ldots(1)$$

$m = 3, C = 1.0\times10^{-12}, \Delta\sigma = 100, a_0 = 0.01m, a_c = 0.03m$

上記の値を代入して，By substituting the above values,

$$N = 1{,}519{,}204$$

レポートの解答例
Sample Answer (6)

亀裂の長さ= aの場合
In the case of crack length = a

シナリオ Scenario 2

まず，繰返し数が100万回の時点で，亀裂の長さがどのくらいに進展するかを求める．式(1)をa_cについて解くと，First, calculate how much length the crack propagates at the 1 million cycles. By solving eq (1) for a_c,

$$a_c = \left\{ \frac{NC(\Delta\sigma\sqrt{\pi})^m(2-m)}{2} + a_0^{\frac{2-m}{2}} \right\}^{\frac{2}{2-m}}$$

$$m = 3, C = 1.0 \times 10^{-12}, \Delta\sigma = 100, a_0 = 0.01m, N = 1{,}000{,}000$$

上記の値を代入して，By substituting the above values,

$$a_c \approx 0.019m$$

100万回以降に関して，新たに$a_0 = 0.019m$とし，$\Delta\sigma = 150$として式(1)を計算すると，By using newly set $a_0 = 0.019m$ and $\Delta\sigma = 150$ in eq (1) for the period after 1 million cycles,

$$N \approx 157{,}759$$

求めたいのは繰返し数の合計値なので，Since we want to obtain total number of cycles, 1,000,000+157,759=1,157,759.