

EXERCISE FAT4: CUMULATIVE DAMAGE

PROBLEM 1

Data

Let us consider the railway bridge illustrated in Fig. 1, its welded plate girders with many vertical stiffeners which are critical fatigue details. The diagram in Fig. 2 shows the stress differences in this construction detail for the passage of a train.

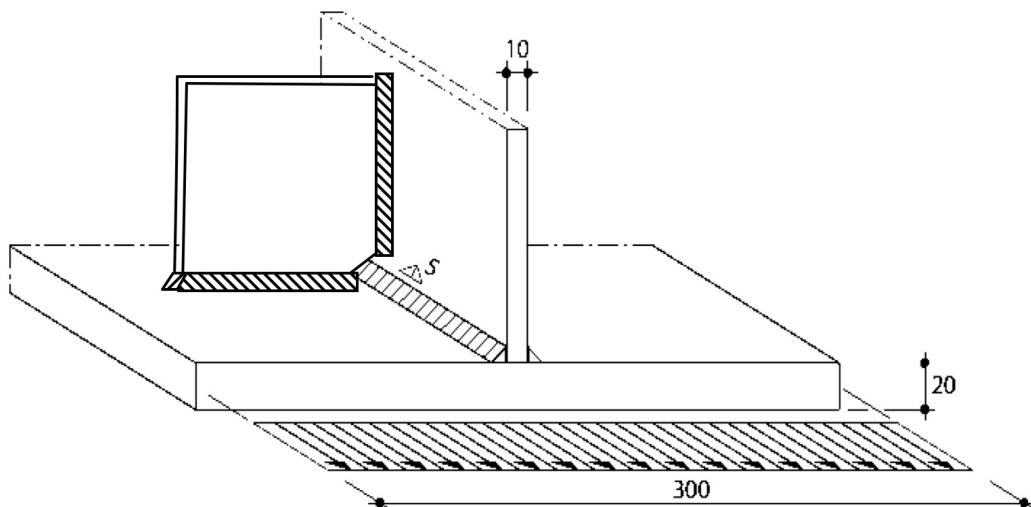


Fig.1: a) picture of the railway bridge, b) detail on the lower flange of a welded plate girder

Questions

1. Which is the fatigue category of the detail in Fig. 1 according to EN 1993-1-9?
2. The stress history due to the passage of a train is given in Fig. 2. Assuming that 6 trains (of the same type) run per hour, 16 hours a day on this bridge, calculate the cumulative damage for a period of 70 years without considering the fatigue limit (S-N curves with a single slope $m = 3$), then considering it (EN1993-1-9 curves).
3. In case that the service life is not met, which solutions could be envisaged? List at least 3 of them.
4. What is the effect of a welded longitudinal stiffener on the flange? (detail see EN 1993-1-9)

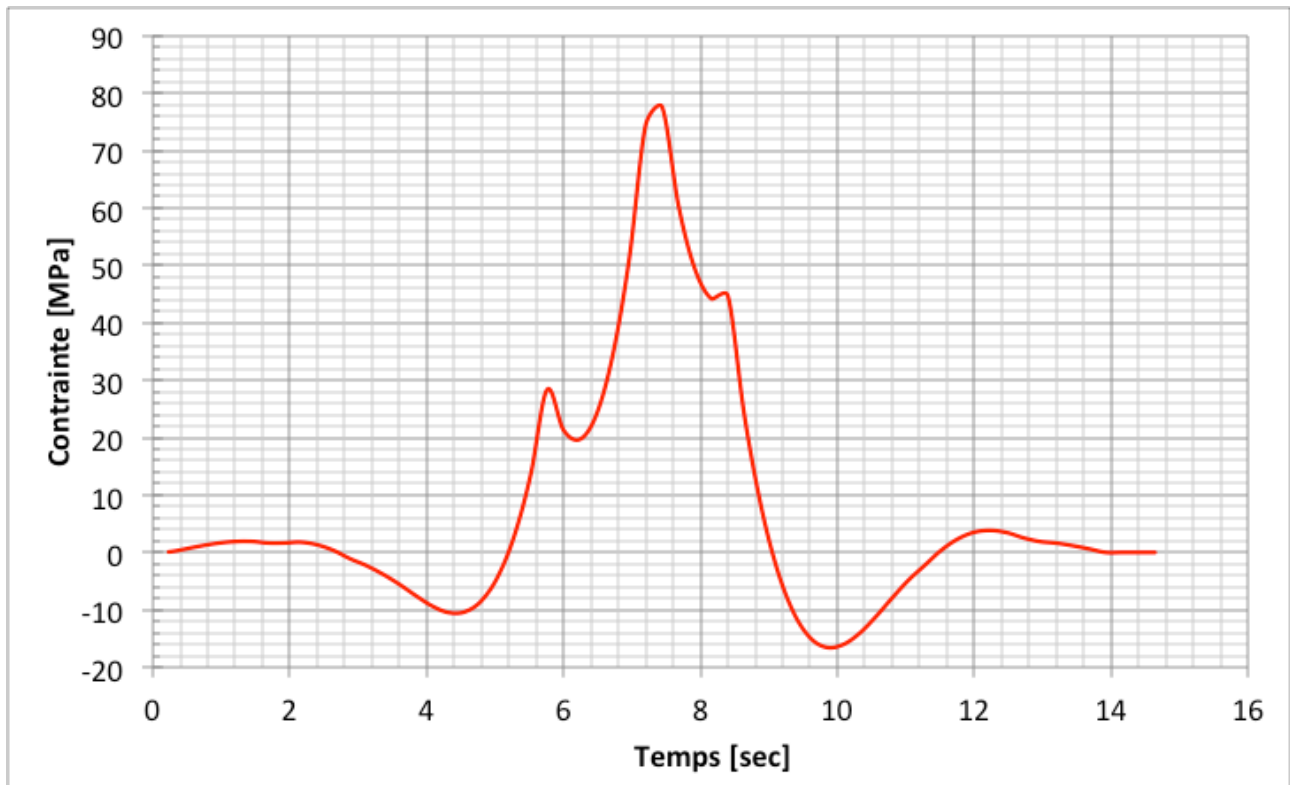


Fig. 2: Strain history due to the passage of a train

PROBLEM 2

For each photo in Figure 3:

1. Explain what detail it is and from where it cracked
2. Give the corresponding detail category and requirements

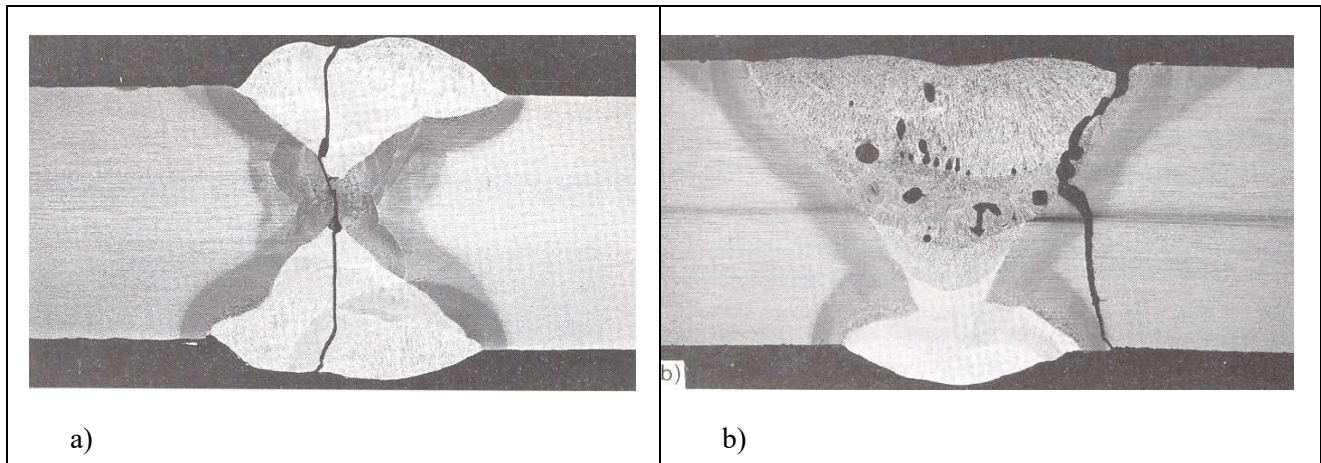


Fig. 3: Examples of cracking in transverse butt welds