IIW Collection

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Gary B. Marquis · Zuheir Barsoum

IIW Recommendations for the HFMI Treatment

For Improving the Fatigue Strength of Welded Joints

INTERNATIONAL INSTITUTE OF WELDING
A world of joining experience

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Gary B. Marquis
Aalto University
Helsinki
Finland

Zuheir Barsoum
KTH Royal Institute of Technology
Stockholm
Sweden

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About the Authors

Gary B. Marquis is a professor of applied mechanics at the Aalto University, Helsinki, Finland, where he currently serves as a dean for school of engineering. Within IIW, he has served as a chairman for Commission XIII (*Fatigue of welded components and structures*) and is currently the president of IIW.

Zuheir Barsoum is an associate professor of lightweight structures at KTH Royal Institute of Technology, Stockholm, Sweden. Within IIW, he is currently leading the XIII-WG2 on *Techniques for improving the fatigue strength of welded joints, components and structures* and serving as vice chair for Commission XIII.

Nomenclature

D	Damage sum for variable amplitude loading
f_y	Yield strength
FAT	IIW fatigue class, i.e., the nominal stress range in MPa corresponding to 95 % survival probability at 2×10^6 cycles to failure (a discrete variable with 10–15 % increase in stress between steps)
$f(t)$	IIW thickness correction factor
k_R	Strength reduction factor for stress ratio, $1 \geq k_R > 0$
K	Stress concentration
m	Slope of the S-N line $1 \times 10^4 \leq N < 1 \times 10^7$ cycles
m'	Slope of the S-N line 1×10^7 cycles $\leq N$
L	Characteristic length used to compute $f(t)$
N	Fatigue cycles
R	Stress ratio
t	Plate thickness
X_N	Improvement factor in life for HFMI-treated welds at $\Delta\sigma$ equal to the FAT class of the as-welded joint: $N_f = X_N \times 2 \times 10^6$
ρ	Weld toe radius
σ	Stress
$\Delta\sigma$	Stress range

Subscripts

eff	Effective
f	Failure (cycles) or fictitious (weld toe radius)
k	Corresponding to the knee point of the S-N curve
S	Structural hot spot stress

max	Maximum value: during one cycle for constant amplitude loading or during one repetition of the spectrum for variable amplitude loading
min	Minimum allowable
nom	Nominal
w	Value computed using the effective notch method

Abstract

High-frequency mechanical impact (HFMI) has emerged as a reliable, effective, and user-friendly method for post-weld fatigue strength improvement technique for welded structures. This guideline presents recommendations on proper treatment procedures, quality control measures, and fatigue strength improvement assessment based on nominal, hot spot, and effective notch stress methods. Recommendations on effect of loading conditions, variable amplitude loading, low cycle fatigue, and consideration of low-stress concentration details are also given. The guideline is applicable to steel structures of plate thicknesses of 5–50 mm and for yield strength ranging from 235 to 960 MPa.

Keywords Peening · Weld toe · Fatigue improvement · High-strength steels · Fatigue strength · Stress analysis