



Whole of Life Asset Management

Facilities → Equipment



How Should Owners Think About Engineering

**Engineering
Influences
Every Phase
of the
Equipment
Lifecycle**

Master Planning →

Design →

Procurement →

Manufacturing →

Operations →

Inspections →

Maintenance →

Rehabilitation/Upgrades →

Replacement



Engineering Influence

Master Planning →

Design →

Procurement →

Manufacturing →

**Majority of
Influence**

Operations →

Inspections →

Maintenance →

**Majority of Life
Cycle**

Rehabilitation/Upgrades →

Replacement



Example of Influencing Design: Structural Fatigue

Best Practices:

- Use Load Spectrums

- Use FEA



Design spectrum:
Single + double cycles

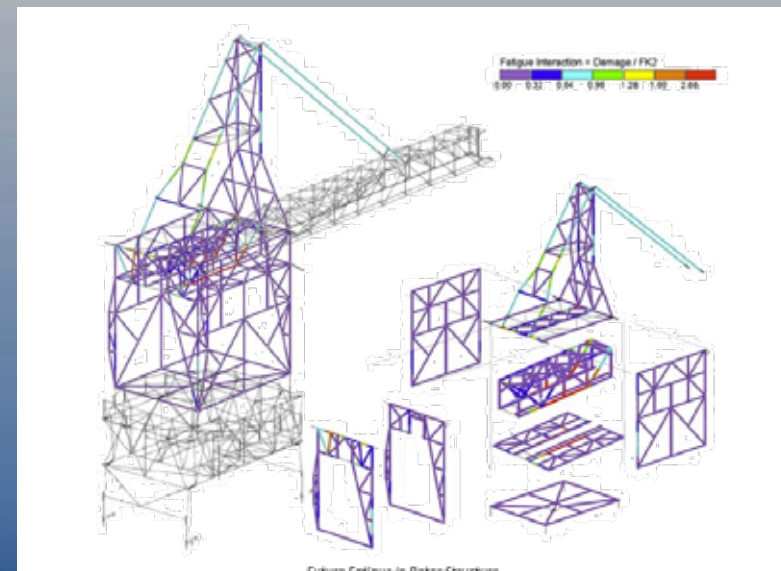
1.0×10^6 moves

1.0×10^6 moves

1.0×10^6 moves

1.0×10^6 moves

4.0×10^6 total design moves



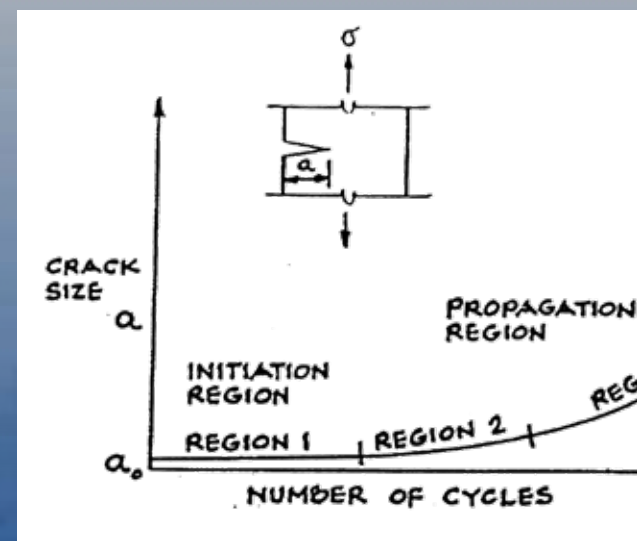
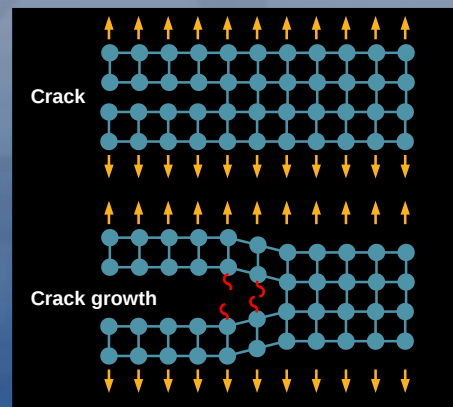
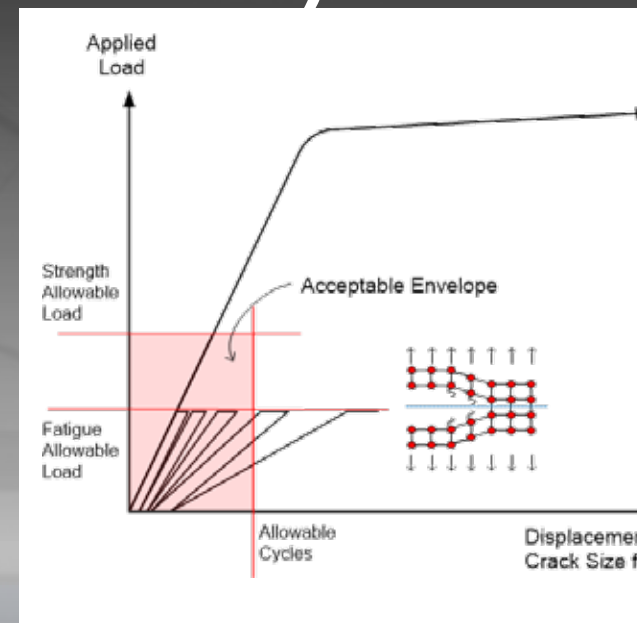
Designing for Fatigue - The (Structural) Details

All steel structures have micro-cracks

Micro-cracks can grow with loads and cycles (Fatigue) if you are 'out of bounds'

Crack growth is predictable through analyses

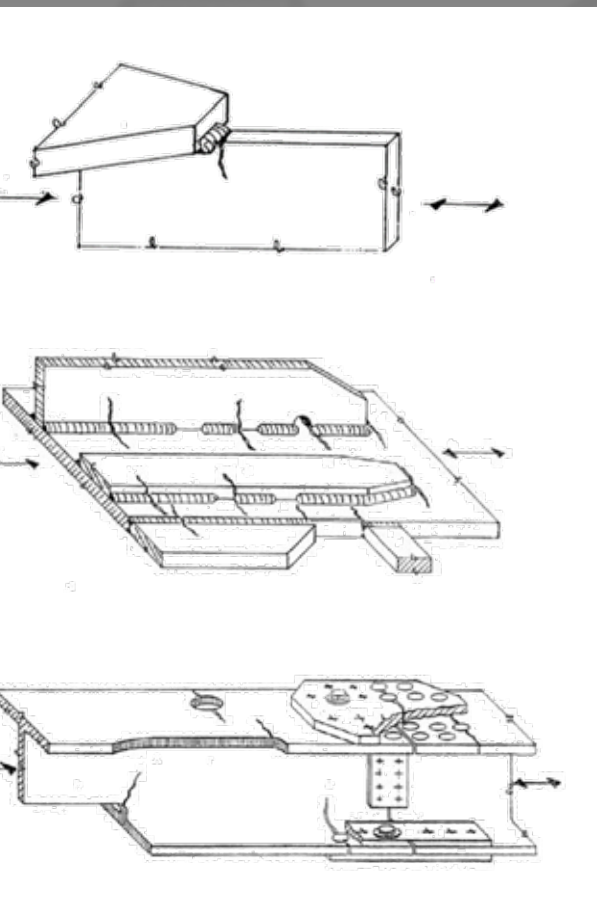
OAL: Stay within Fatigue Limit



Examples of Fatigue Details

Poor details promote cracking

Better details = Higher reliability at no additional cost



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FATIGUE DETAIL GUIDELINES

VERSION 1.0, NOVEMBER 2011

Acceptable

Not Acceptable

Acceptable

Not Acceptable

Cruciform Weld

UT 100%
For components carrying the calculated weld stress

For feature critical members ("C" class). The through-thickness, yield, ductility, and C/N properties shall comply with the requirements for plate tension plates.

UT inspect to check for lamellar tears before and 30 hours after welding.

Avoidance of Wraparound Weld

Classification of Select Fatigue Details
Based on BS 5400 and BS 7608
(EN 1093-1:9-2005)

Relative Fatigue Life
Compared to Class

Class	D	E	F	F2	G
D	1.00	1.46	2.41	3.35	6.05
E	0.68	1.00	1.65	2.42	4.15
F	0.41	0.61	1.00	1.47	2.52
F2	0.28	0.41	0.68	1.00	1.71
G	0.15	0.24	0.40	0.58	1.00

Note: Based on BS 5400, BS 7608, and reliability of 97.8%.

Example: For a given location on a crane, the fatigue life of a class F detail is expected to be 2.52 times that of a class G detail.

Manufacturing for Fatigue

Evaluating Execution of the Design

Robust QC and QA inspections

Collaborate w/ OEM

Qualified Welding Inspectors (NDT)

Proper Testing Equipment

Record Keeping





Fatigue Engineering - Drudgery Phase

Master Planning →

Design →

Procurement →

Manufacturing →

**Majority of
Influence**

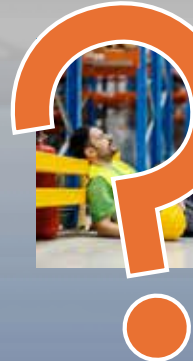


Operations →

Inspections →

Maintenance →

**Majority of Life
Cycle**



Rehabilitation/Upgrades →

Replacement



Reliability & Resiliency

Proper Inspections
+ Maintenance

= Extend the
structural
operating life cycle

Indefinitely.

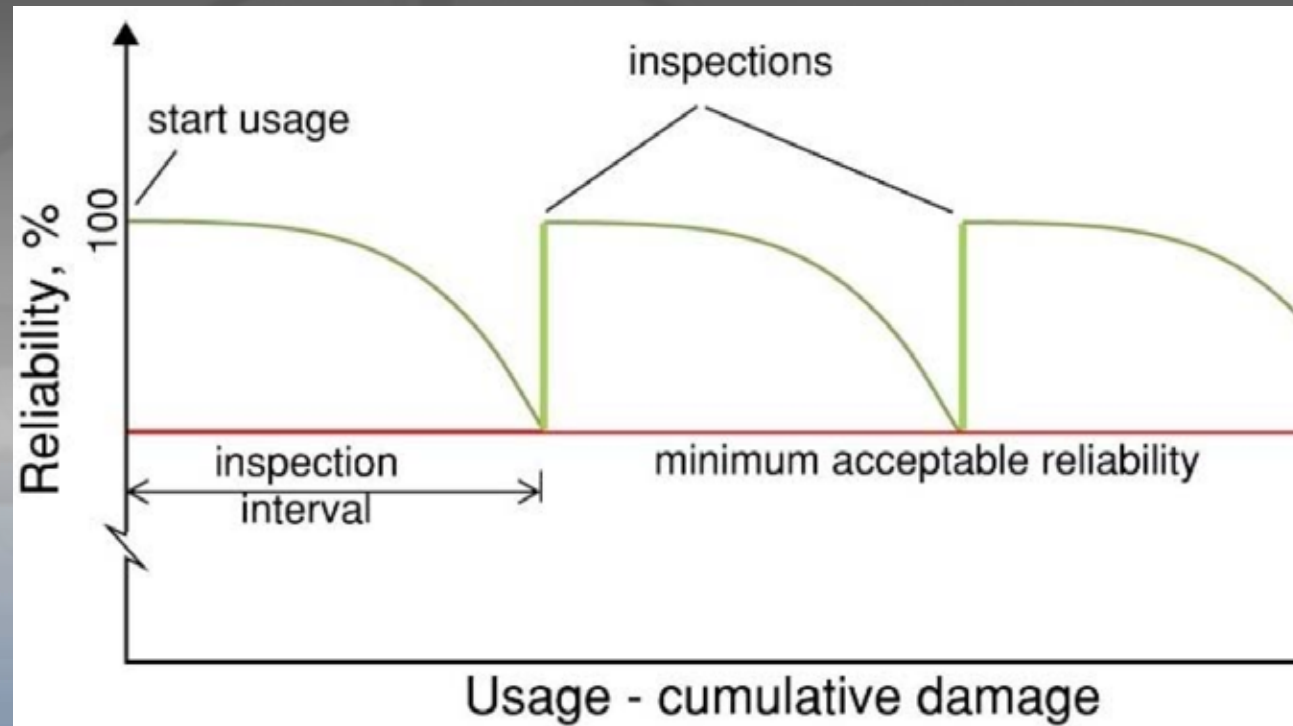


Figure 2: Reliability with usage and inspection

SMP = Prolonged Structural Life



Engineering Influence

Master Planning →

Design →

Equipment Procurement →

Facility Construction →

**Majority of
Influence**



Operations →

Inspections →

Maintenance →

**Majority of Life
Cycle**



Rehabilitation/Upgrades →

Replacement

**Session 3D
Discussion**





Thank You

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