Accident Prevention Through Engineering Design

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Safety vs. Accident Prevention

- Up to now, we have focused on safety in the wood shop as it relates to optimum operation of tools and in wearing gear.
- Another element to safety is preventing accidents due to material failure.

Material Failure is Affected by:

- Optimum design of projects
- Optimum design of tools
- Optimum material selection in tools and projects (to be discussed later)

Fundamental Design Criteria

- Avoid sharp changes in dimensions in preference to rounded or filleted transitions.
- Build flexibility into projects.
- Avoid dramatic notches or groves in elements.

Which is Stronger? Why?

A

B

Examples

- A classic example is on fishing line with a leader; greater the difference in rating of the line and the leader, the more likely the leader will break with a fish, especially as the length of line is reeled in.
- Similar examples occur in the spindles of chairs or legs of chairs and tables.
- A simple explanation is that one long slender element acts like a long spring capable of absorbing a lot more energy than a short spring connected to a very strong spring.

Which is Stronger? Why?

A

B

TABLE A-12 Charts of Theoretical Stress-concentration Factors K_t (continued)

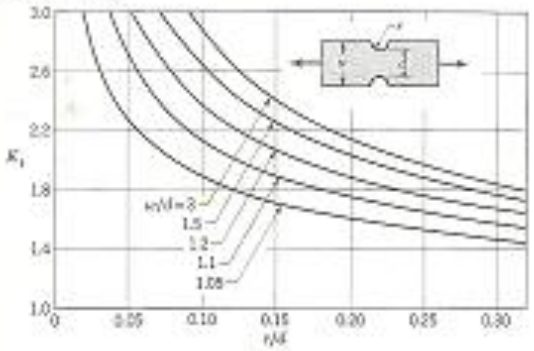

Fig. A-12-3 Notched rectangular bar in tension or simple compression. $\sigma_0 = F/A$, where $A = (w - d)t$ and t is the thickness.

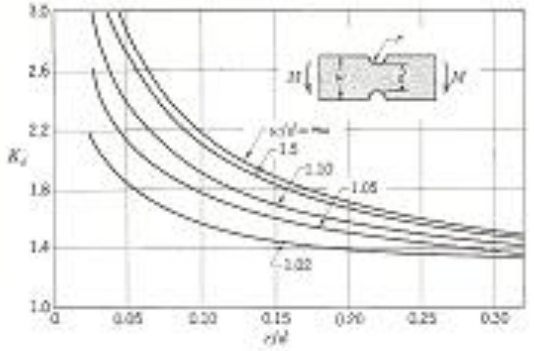

Fig. A-12-4 Notched rectangular bar in bending. $\sigma_0 = Mc/I$, where $c = d/2$ and $I = td^3/12$. The thickness is t.

TABLE A-12 Charts of Theoretical Stress-concentration Factors K_t (continued)

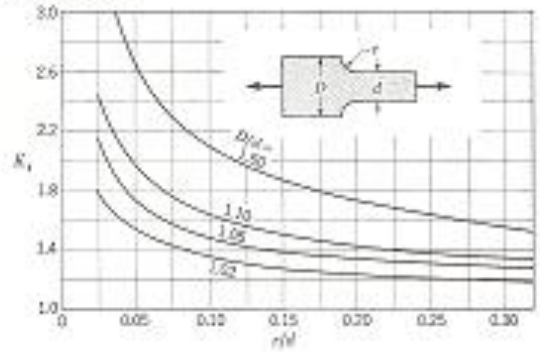

Fig. A-12-5 Rectangular filleted bar in tension or simple compression. $\sigma_0 = F/A$, where $A = dt$ and t is the thickness.

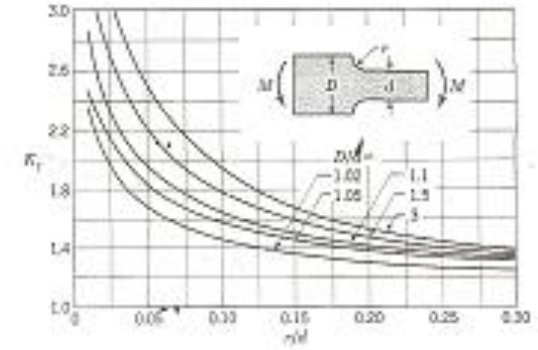

Fig. A-12-6 Rectangular filleted bar in bending. $\sigma_0 = Mc/I$, where $c = d/2$, $I = td^3/12$, and t is the thickness.

- A reasonable fillet or transition radius will make the shaft or rod 2 to 3 times stronger than without a fillet.

Examples

- Chair components and legs: avoid radical changes in dimension without providing a fillet.
- Don’t forget tools: choose tools with fillet built into transition points…files, drill bits, router bits, etc.

Note fillet on file to improve strength

Notches or Ringed Groves also Compromise the Strength of Shafts and Rods

- Notches or groves can also weaken elements by a factor of 2-3.
- A straight chair rung can be stronger than one with major diameter change, unless it is oversized.

Materials

- Don’t forget the quality of material (wood with knots, grain run-out).
- And, drilled holes weaken the component.

Recommendations

- Watch your design and eliminate sharp transitions of elements.
- Inspect existing tools, knives, lathe tools, chisels, etc. looking for missing fillets.
- Build in long tapered shapes into elements when possible.
- Avoid notches or holes in elements.
- Avoid poor material integrity which compromises strength.