

MIT OpenCourseWare  
<http://ocw.mit.edu>

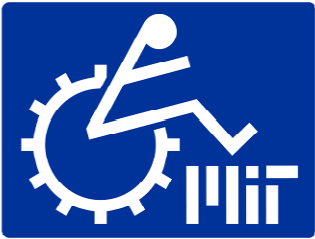
EC.721 Wheelchair Design in Developing Countries  
Spring 2009

For information about citing these materials or our Terms of Use, visit: <http://ocw.mit.edu/terms>.



## MATERIAL PROPERTIES AND PERFORMANCE





## HOT WORKING VIDEOS

- **Hot forging a nail**

<http://www.youtube.com/watch?v=7YNbMAAxvnQ>

- **Cold forging a metal bar**

<http://www.youtube.com/watch?v=Zdi6C-oADEI>

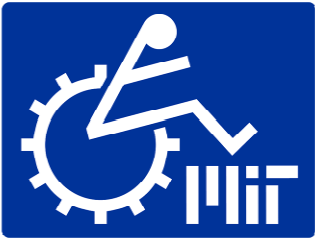


## MECHANICAL PROPERTIES OF 1020 STEEL

Effects on performance from different processes

<b>Treatment</b>	<b>Tensile Strength (MPa)</b>	<b>Ductility (%EL)</b>
<b>Hot rolled</b>	<b>210</b>	<b>25</b>
<b>Cold drawn</b>	<b>350</b>	<b>15</b>
<b>Annealed (@ 870 deg C)</b>	<b>295</b>	<b>36.5</b>
<b>Normalized (@ 925 deg C)</b>	<b>345</b>	<b>38.5</b>

From W. Callister, Materials Science and Engineering



## STEEL YIELD STRENGTH VS. ELONGATION

Steel alloys with different amounts of carbon

<b>AISI #</b>	<b>Tensile Strength (MPa)</b>	<b>Ductility (%EL)</b>
<b>1010</b>	<b>180</b>	<b>28</b>
<b>1020</b>	<b>205</b>	<b>25</b>
<b>1040</b>	<b>585</b>	<b>19</b>
<b>1080</b>	<b>980</b>	<b>13</b>
<b>1095</b>	<b>830</b>	<b>10</b>

From W. Callister, Materials Science and Engineering



# MODULUS VS. DENSITY

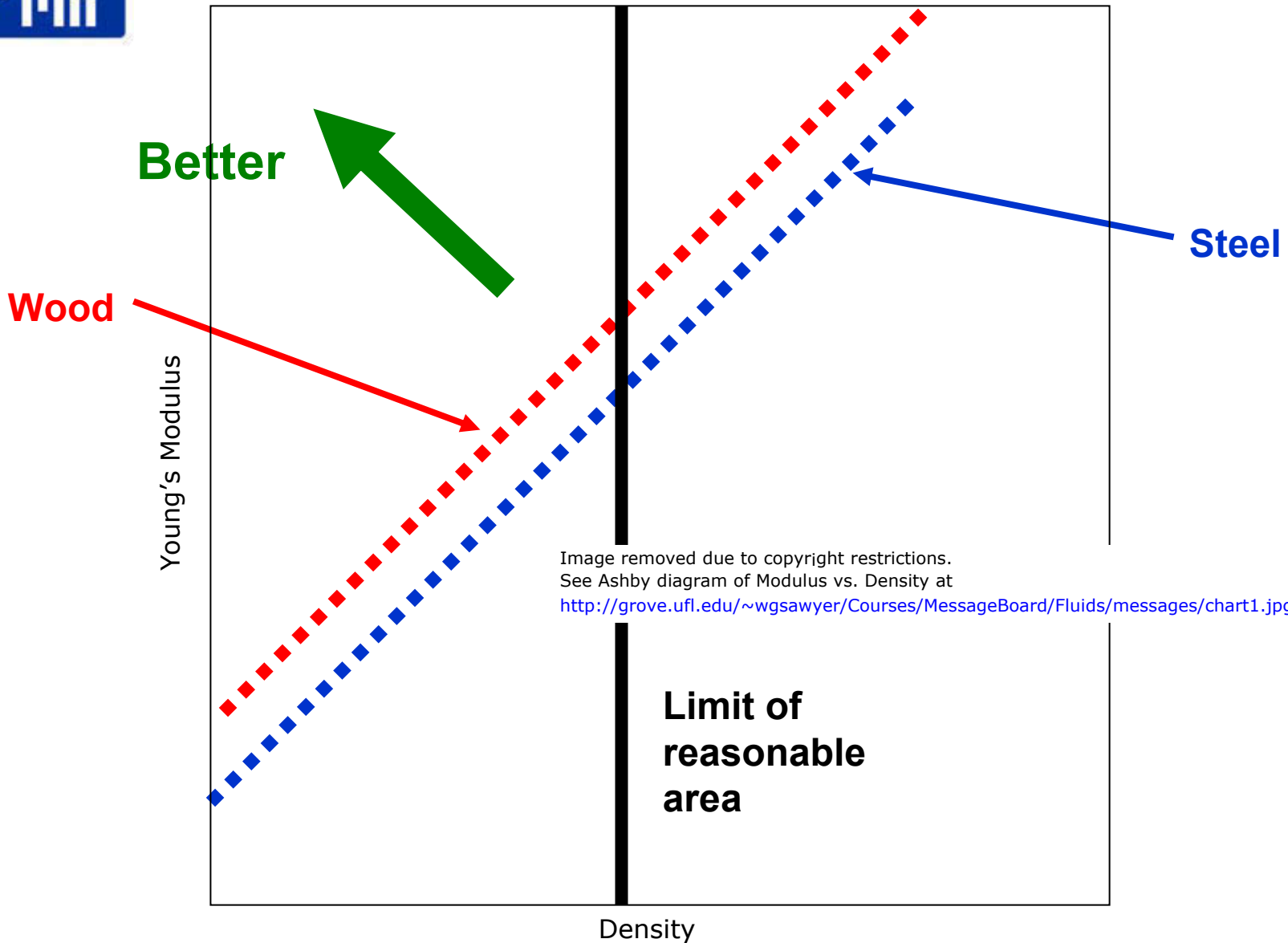


Image removed due to copyright restrictions.  
See Ashby diagram of Modulus vs. Density at  
<http://grove.ufl.edu/~wgsawyer/Courses/MessageBoard/Fluids/messages/chart1.jpg>



# STRENGTH VS. DENSITY

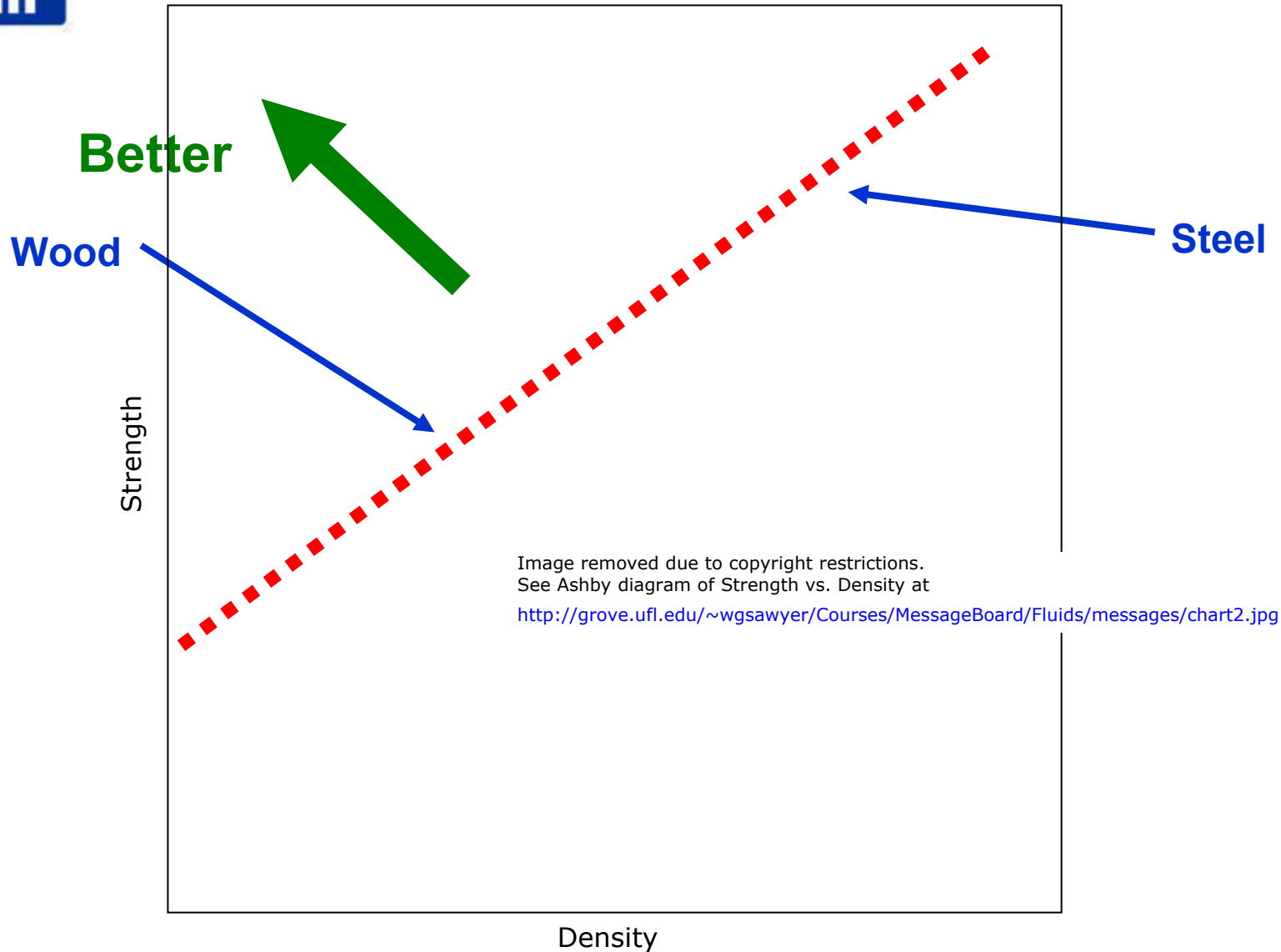


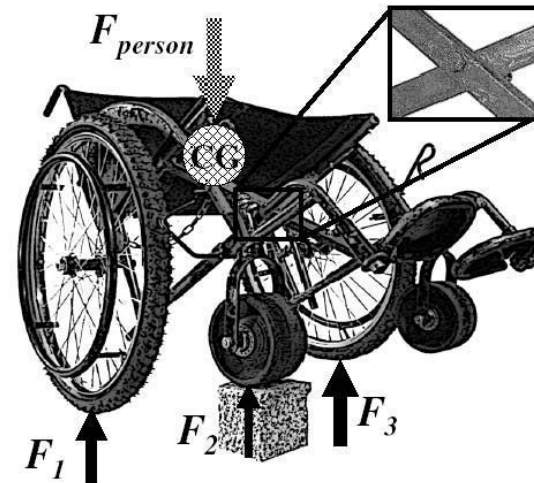
Image removed due to copyright restrictions.  
See Ashby diagram of Strength vs. Density at  
<http://grove.ufl.edu/~wgsawyer/Courses/MessageBoard/Fluids/messages/chart2.jpg>



## HOMEWORK

- Read “Mechanical Principles of Wheelchair Design”

### Mechanical Principles of Wheelchair Design



**Amos Winter**

Graduate Student, Department of Mechanical Engineering  
Massachusetts Institute of Technology

**Ralf Hotchkiss**

Chief Engineer  
Whirlwind Wheelchair International

*This manual is free to anyone. Please photocopy and distribute.*