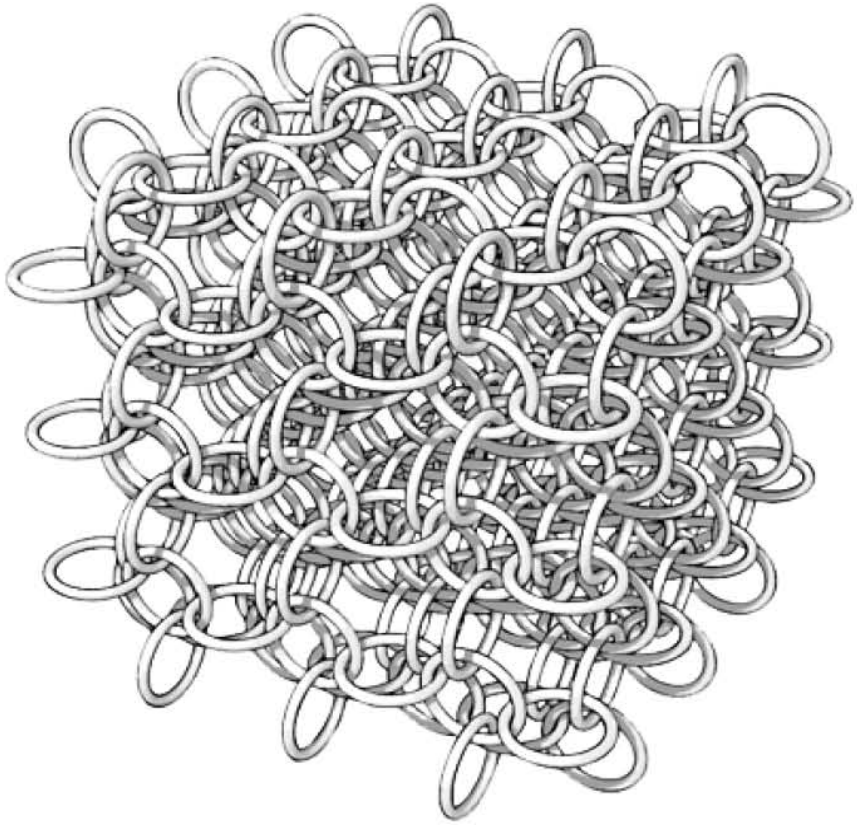

Digital Materials

Kenneth C. Cheung
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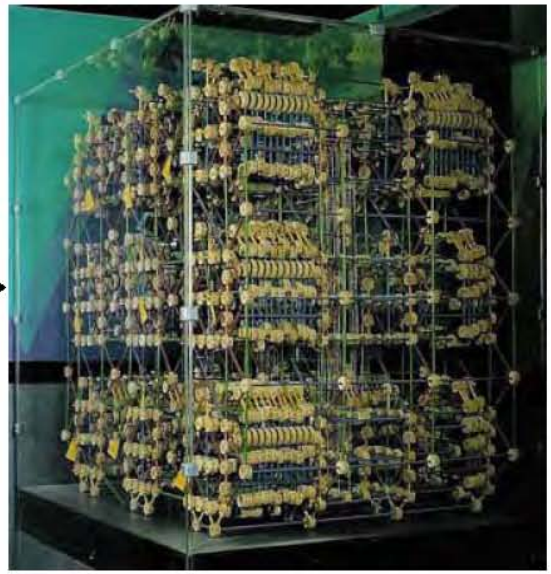
The Science of Digital Fabrication, March 7, 2013

Digital Materials



Hillis, Silverman, 1975

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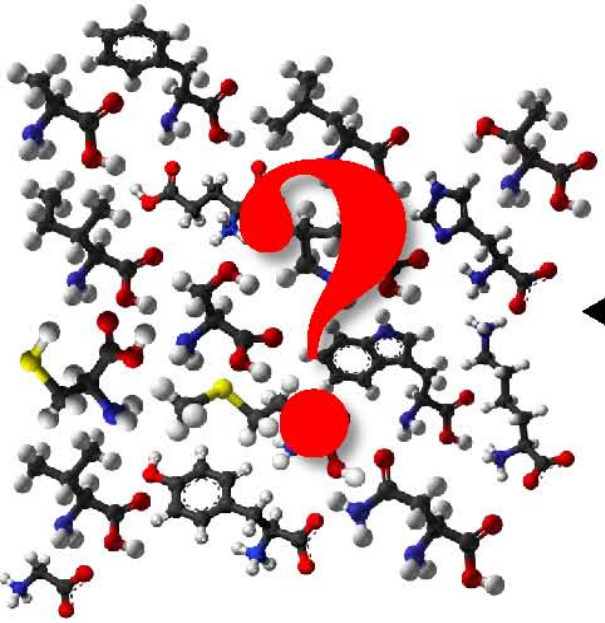
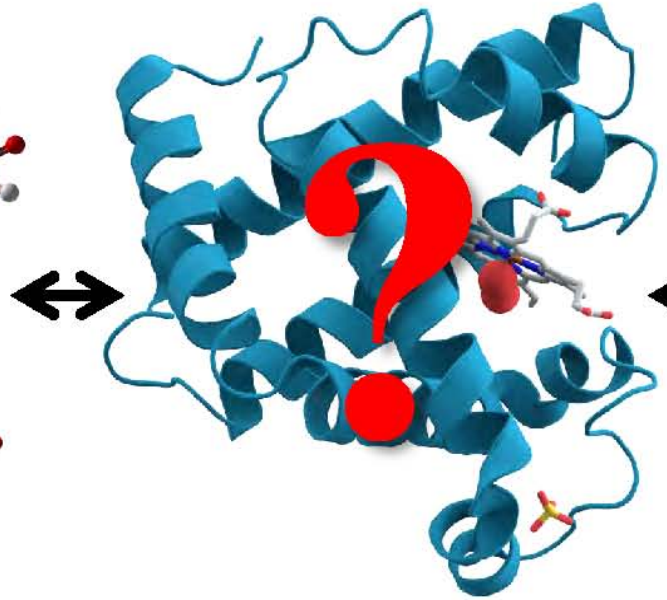
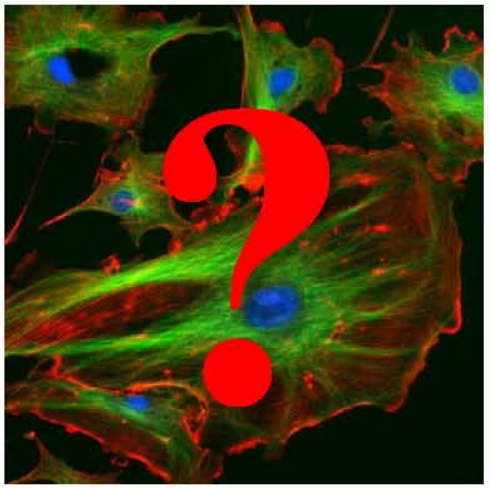






rsb.info.nih.gov/ij/images/

Digital Materials

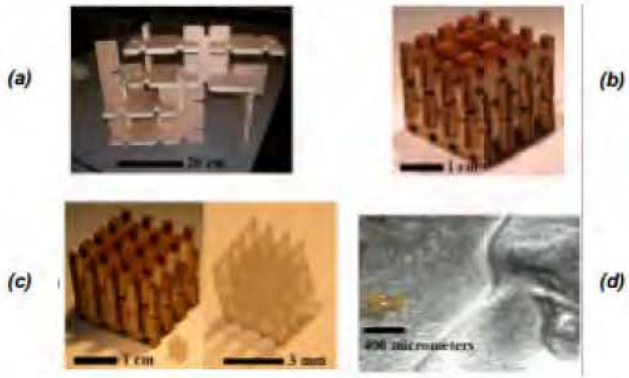


Figure 2 *GIK structures of different sizes & shapes: (a) meter (in plywood) , (b) centimeter (plywood), (c) millimeter (celluloid) , (d) µm (Kepton). You can see the mm and cm scale structures side by side in (c). The µm structure is on top of a dime for scale purposes.*

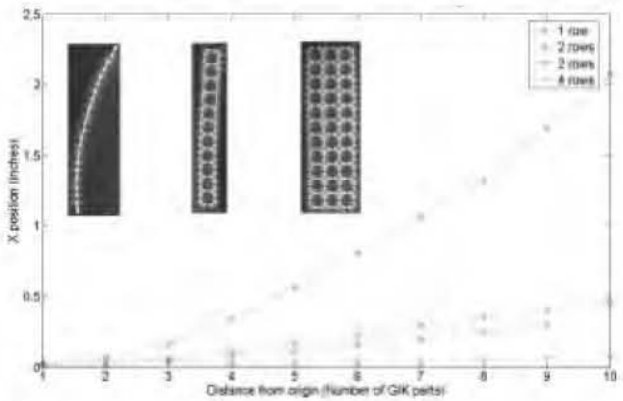


Figure 11 *Error prevention: the x position of a piece in a GIK structure is constrained by the other GIK parts in the structure. Therefore the larger the structure along the y axis and the smaller the variation of the part's x position as measured here.*

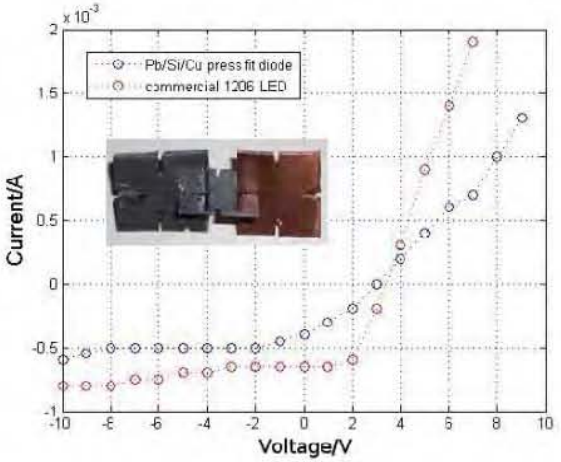


Figure 3 *GIK parts made out of different material: plywood, Plexiglas, aluminum and fiberglass composite material, stainless steel, transparency (celluloid) and cardboard.*

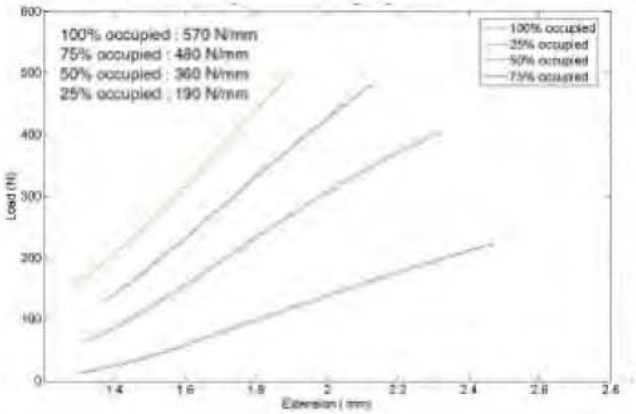


Figure 12 *Material Tuning : one can vary the percentage of sites occupied in a GIK structure and therefore tune the mechanical behavior of the structure. Shown here: the variation of the compression modulus (the slope of load/extension graphs) for 4 different occupancies.*

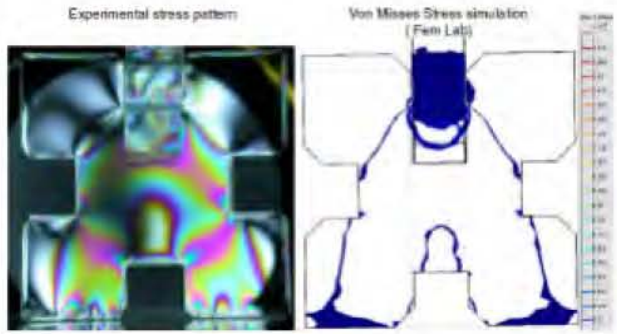
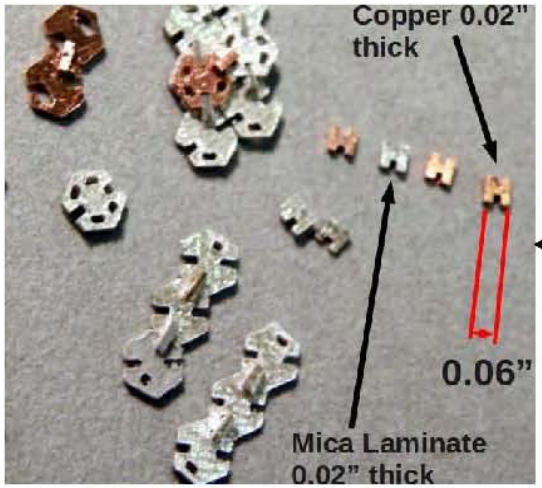
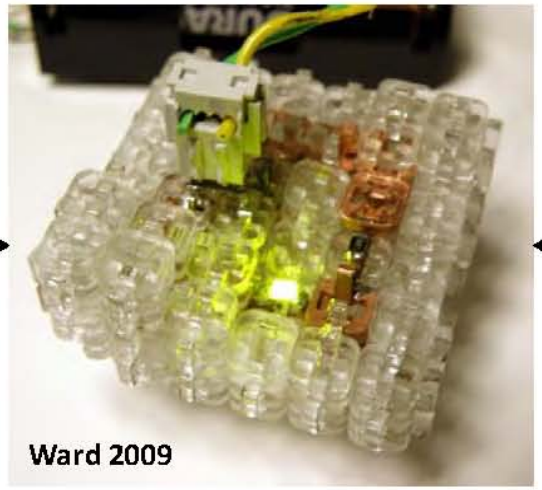


Figure 8 *The experimental and simulated (using Femlab finite element simulation software) stress pattern in a square GIK. A force of 500 N was applied and locally the stress can reach up to 16000 N.*

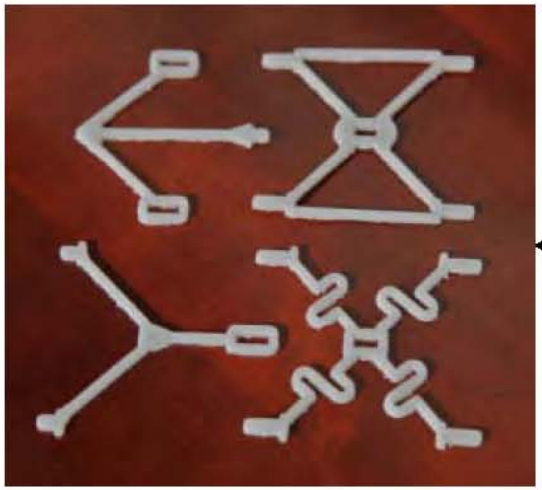
G. Popescu, N. Gershenfeld, T. Mahale 2006

Digital Material Electronics





Digital Material Mechanics



NASA FS-1997-07-24-LaRC

Aerostructures

Boeing 787
Goal ~144 hour assembly

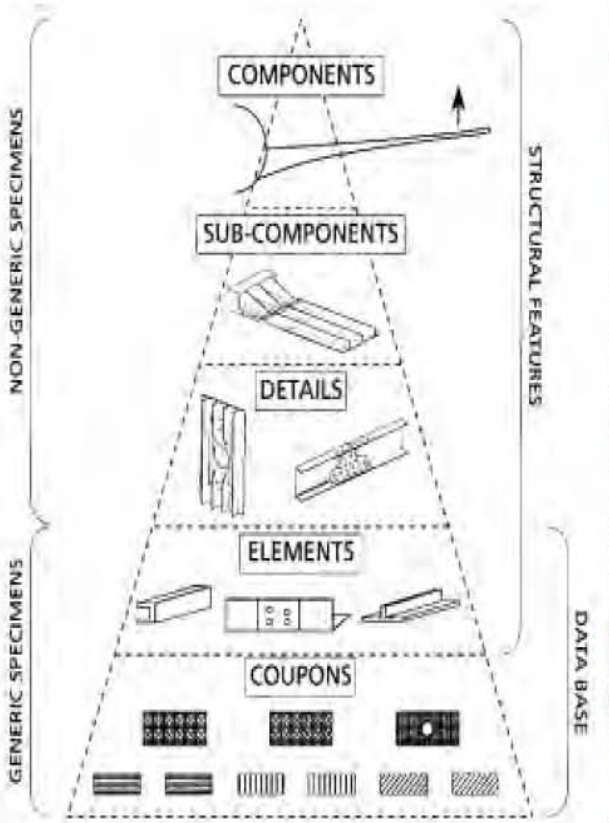
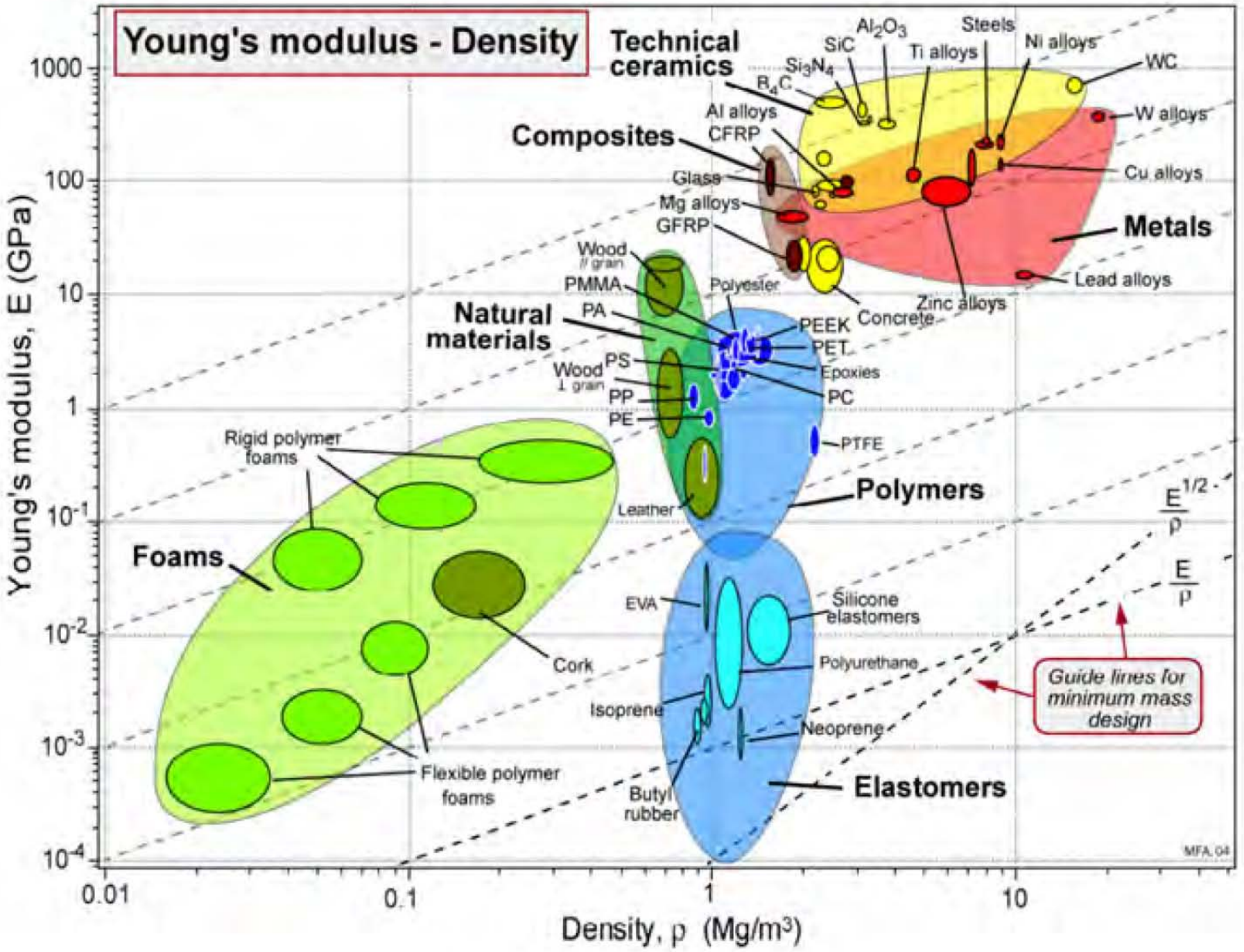
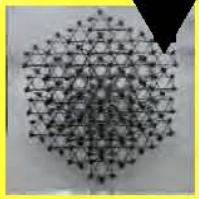


FIGURE 2.1.1 *The pyramid of tests (Reference 2.1.1(a)).*



Ashby Material Property Chart (http://www.grantadesign.com/download/charts/new_modulus_density.pdf)

Digital Composites



: Ashby Material Property Chart (http://www.grantadesign.com/download/charts/new_modulus_density.pdf)

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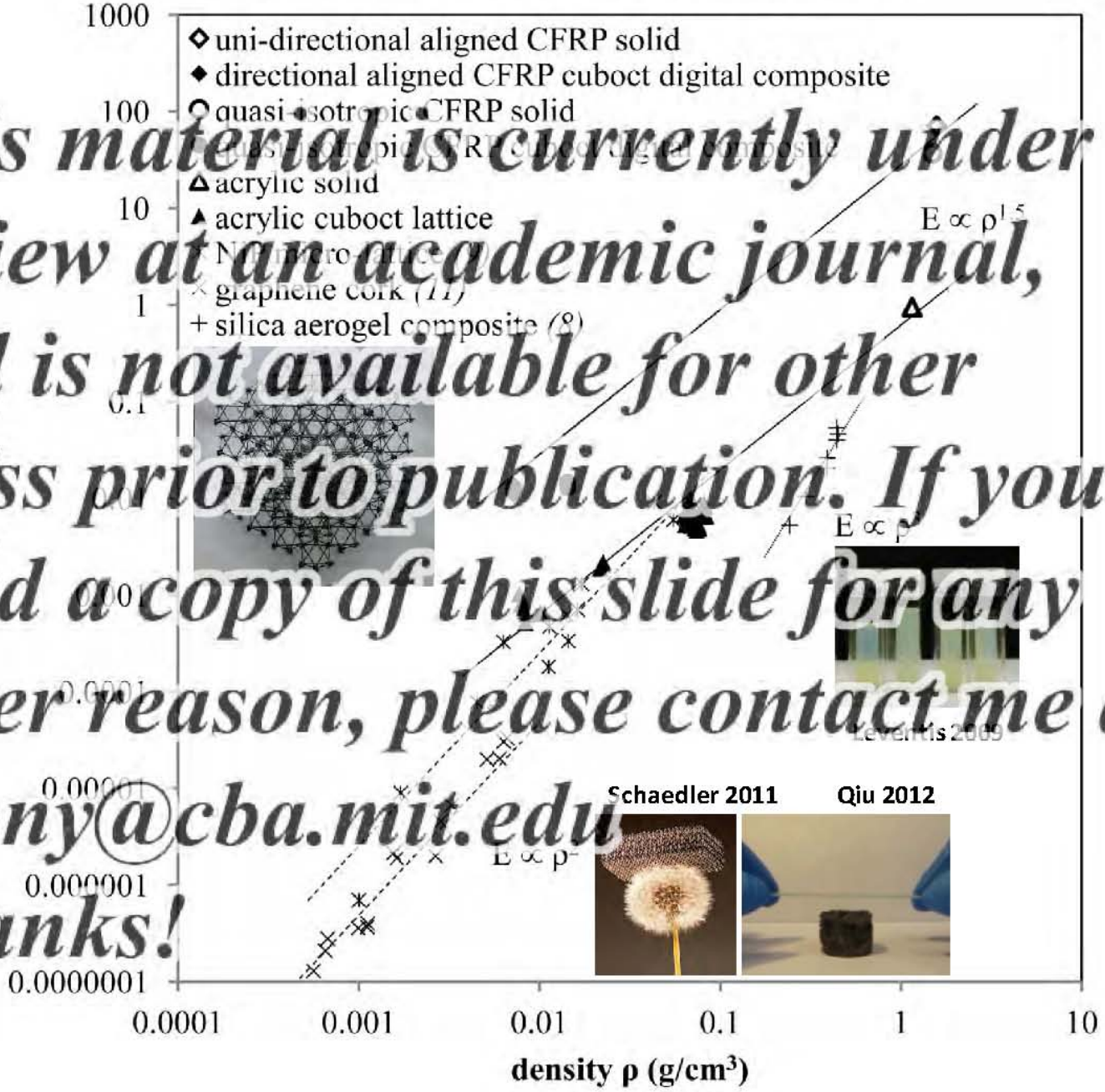
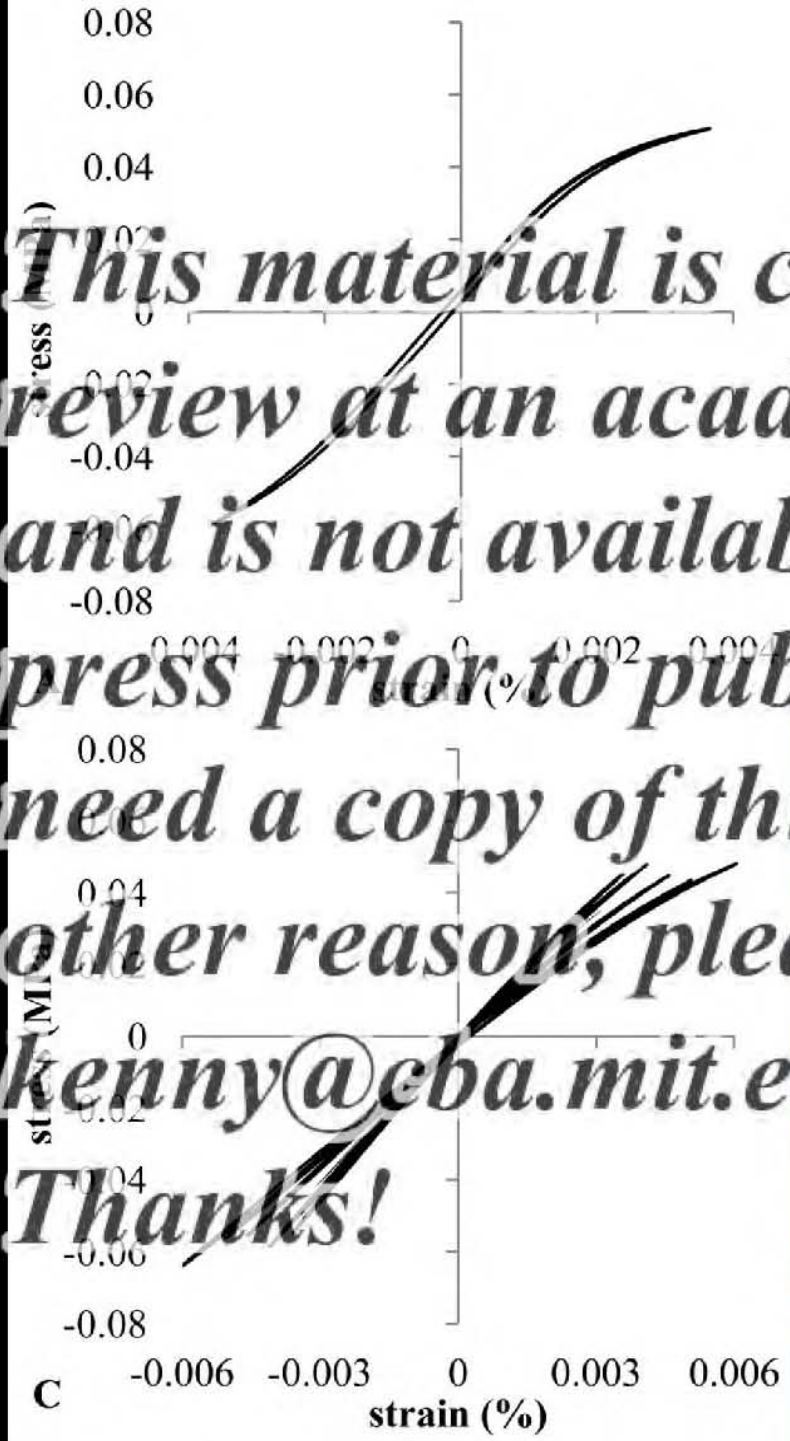
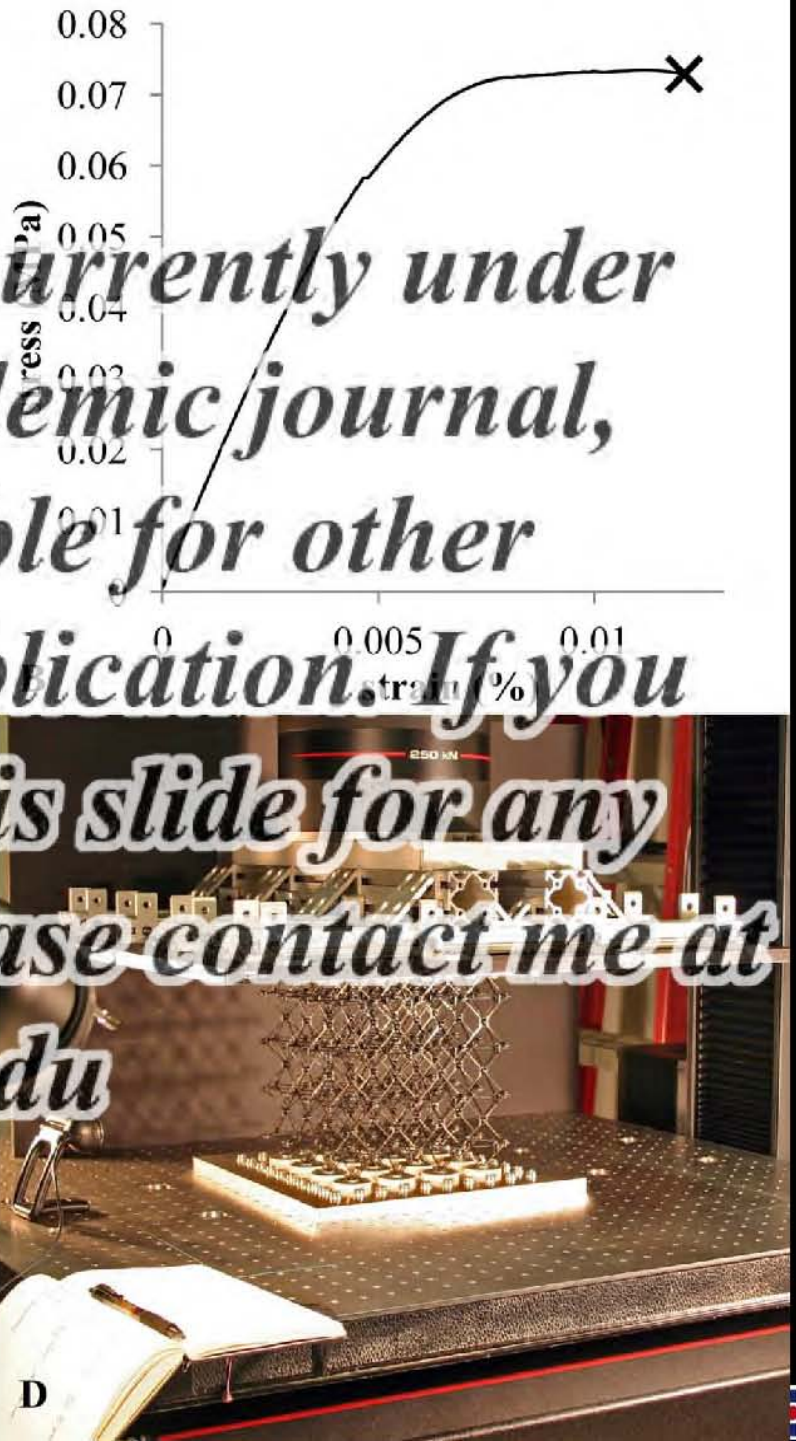
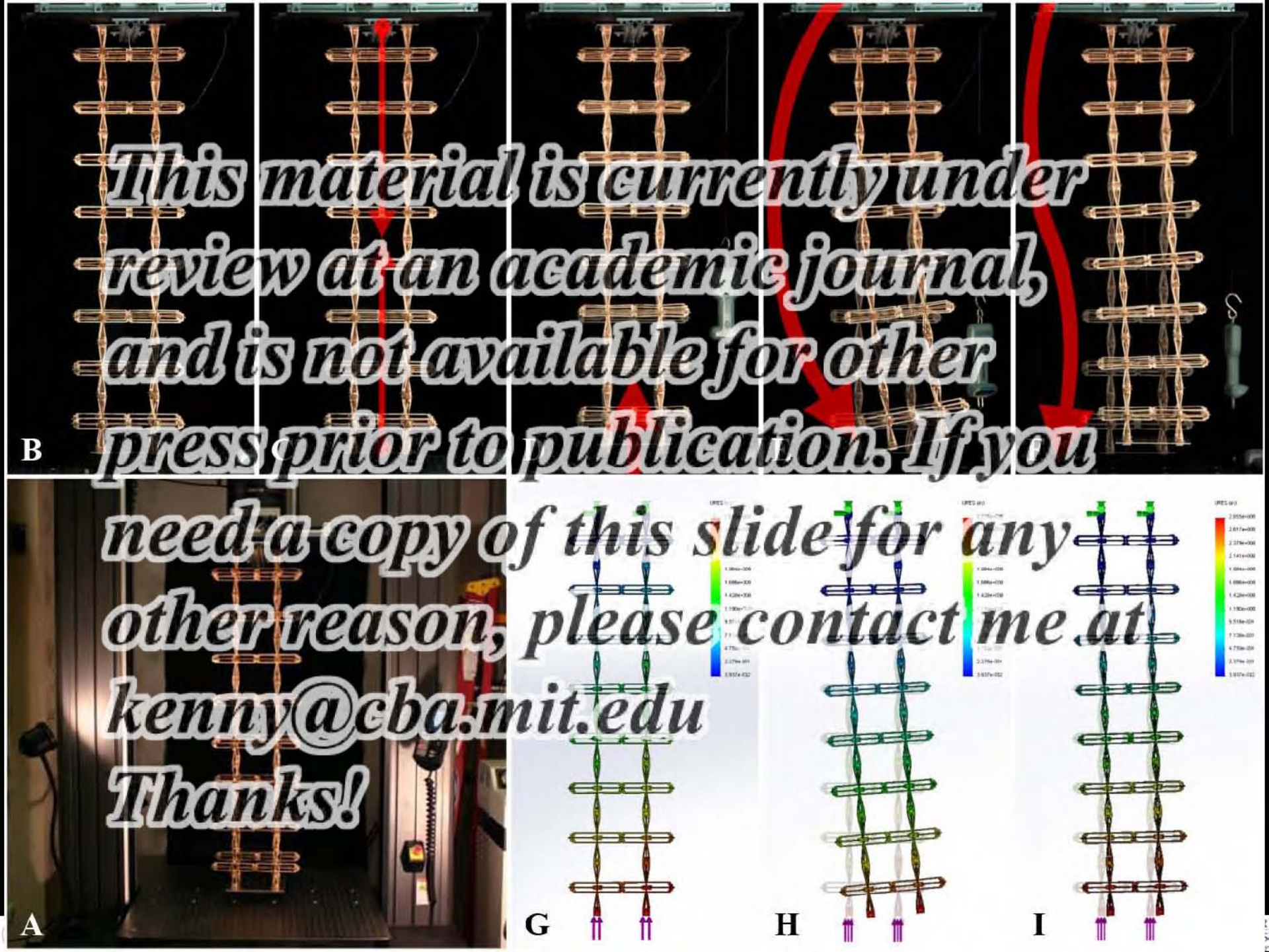
Thanks!

Ultra-Light Materials Modulus Scaling with Density





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A
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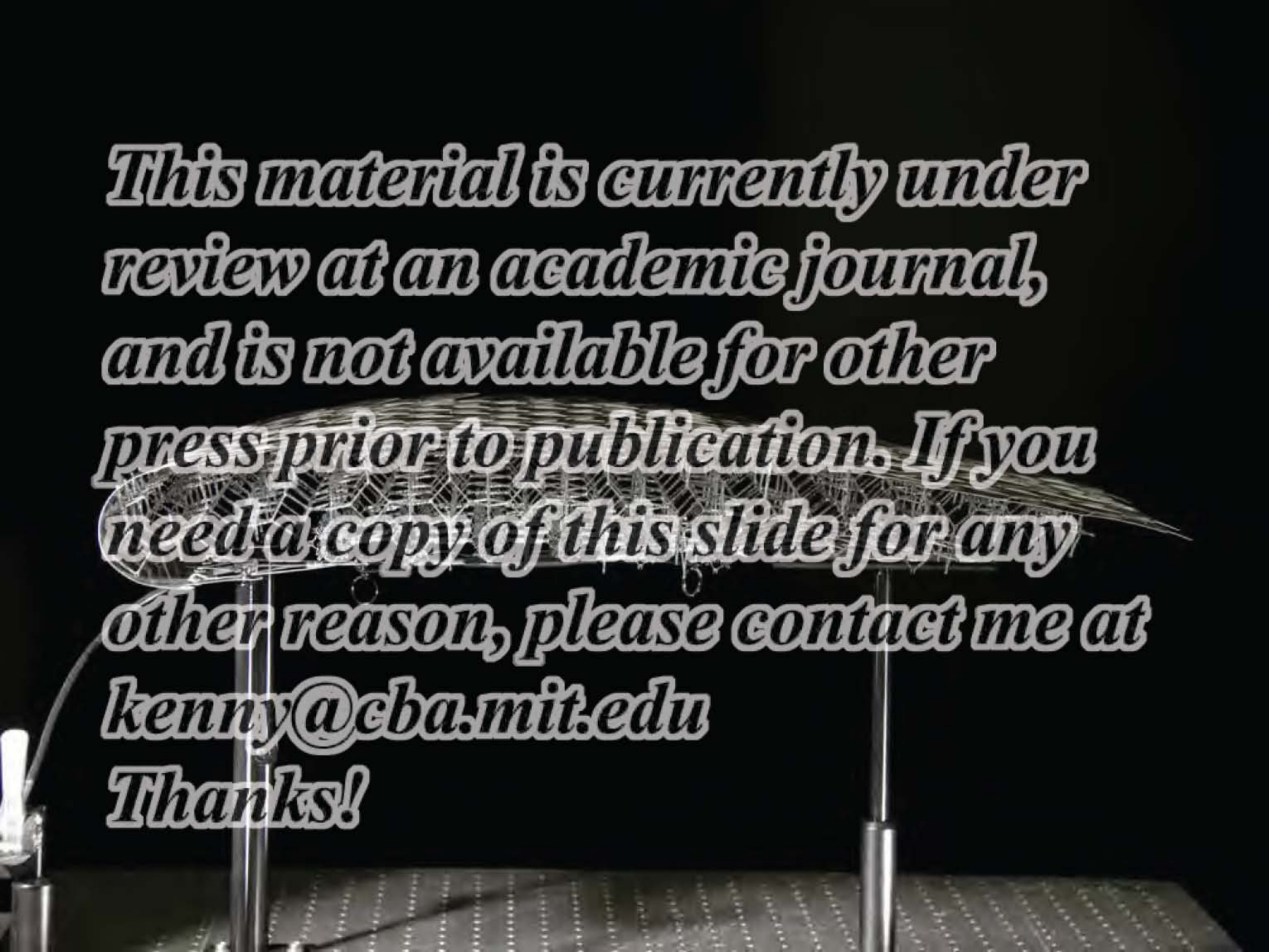
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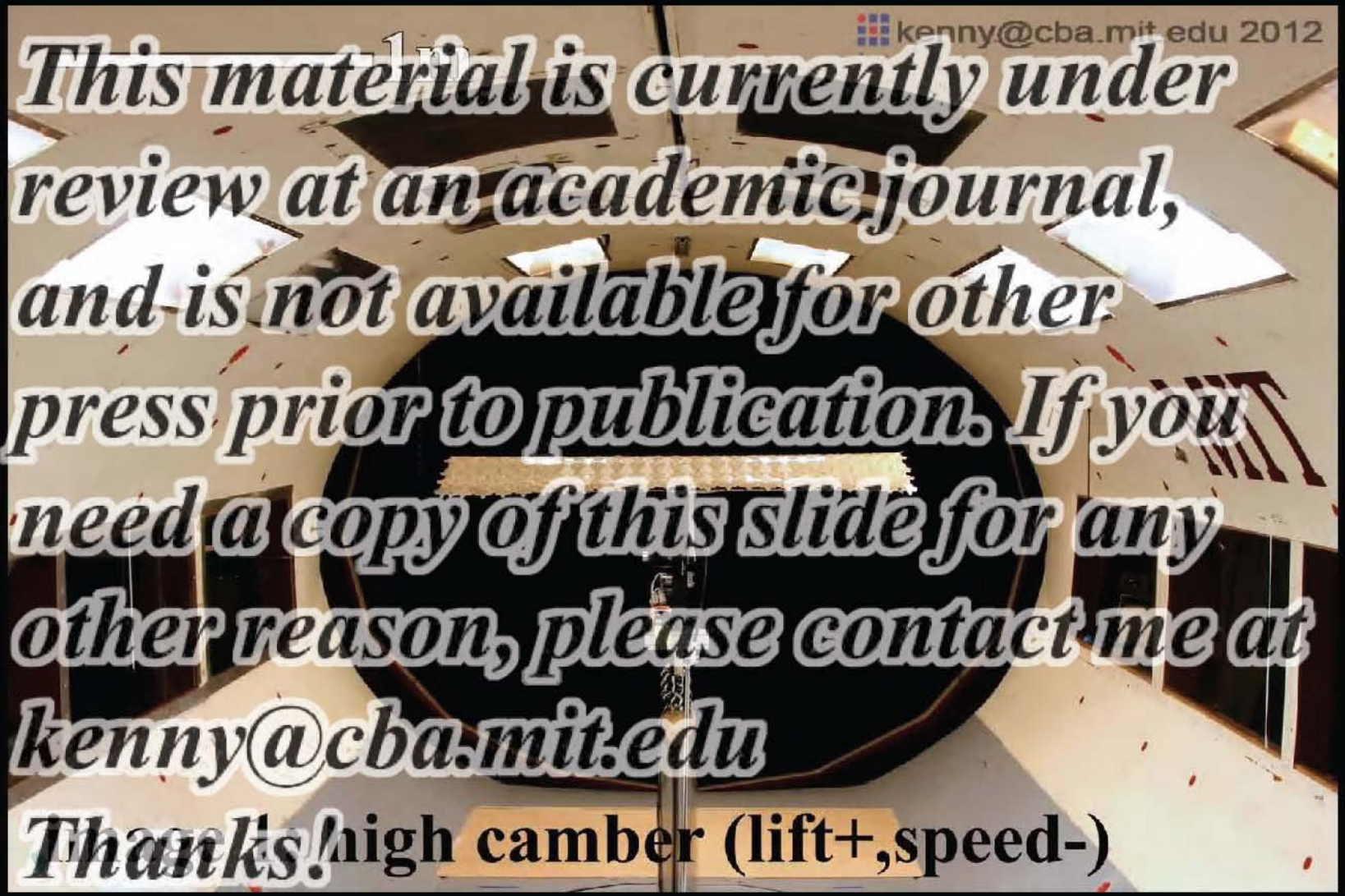
kenny@cba.mit.edu 2012
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Thanks!
high camber (lift+,speed-)

Eiffel Tower, 1889

18,000 strut members, 2.5 million rivets, ~2 years

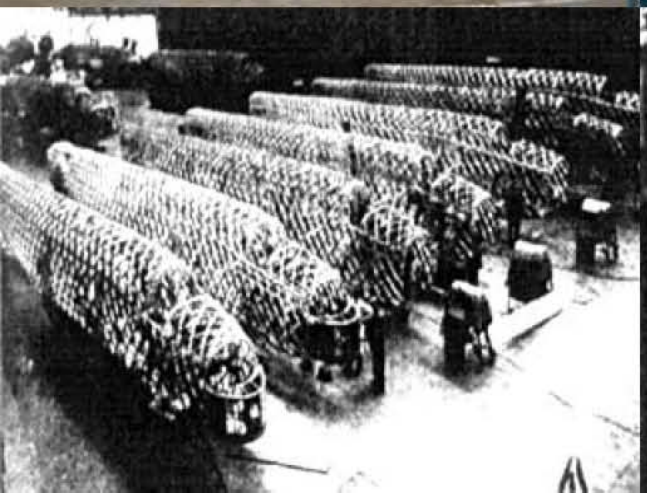
Aerostructures

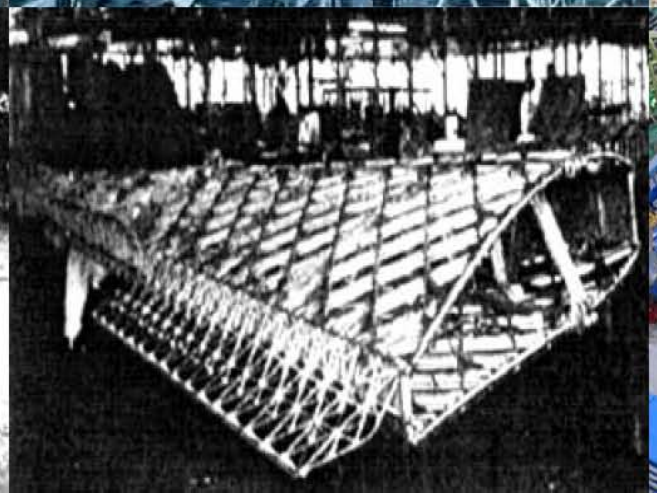
Vickers Wellington, 1935

24 hour production

Boeing 737

~1 million parts, ~1 million fasteners, ~24 hour assembly





PROGRAMMABLE MATTERS

kenny@cba 2012