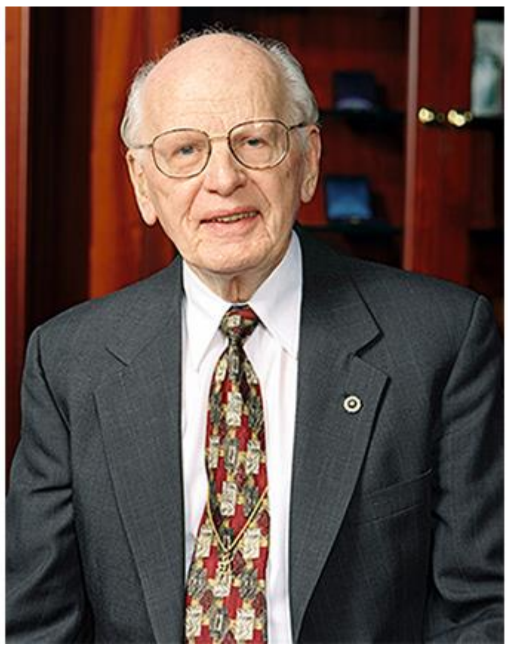
36270 SOLDADURA

El presente archivo contiene:

IN MEMORIAM



OMER W. BLODGETT (Cleveland, Ohio ; Nov 27, 1917 - Enero 11, 2017)

Es imprescindible recordar a uno de los principales pioneros de la soldadura estructural, recientemente fallecido, quien vivió y respiró soldadura, contagiando su pasión a los soldadores e ingenieros de todo el mundo.
Se involucre con la soldadura a la edad de 10 años, cuando hace su primera soldadura de arco eléctrico con su padre en una máquina de la Lincoln. Mientras estudiaba la Secundaria, siguió trabajando con su padre y en 1938 se convierte en un soldador certificado para aplicaciones en recipientes de alta presión. Se gradúa de Ingeniero metalúrgico en 1941 y de Ingeniero Mecánico en 1974, en la Universidad de Minnesota.
Desde 1945 hasta su fallecimiento trabajó para la Lincoln Electric Co., en Cleveland. Reconocido internacionalmente por dos de sus libros, *Design of Welded Structures* y *Design of Weldments*, y sus muchos artículos sobre el análisis, diseño y detallado de soldaduras, control de la distorsión en piezas soldadas, fracturas frágiles y fatiga. Ver **36303** *Tesoros de Blodgett* por Erin Cristie.

Estos textos publicados en la década de 1960, se mantienen como referencias y se re-editan, entre otros motivos, por el análisis teórico y el desarrollo práctico de ejemplos de muchos tipos de soldaduras, así como por la calidad de las ilustraciones y el bajo precio. Aunque utilizan el Método AISC de las Tensiones Admisibles, ASD, pueden rápidamente actualizarse al Método de los Estados Límites, LRFD, como muchas veces se hace en las asignaturas de pre y postgrado de Estructuras de Acero.
Blodgett fue de los primeros en explicar las fallas causadas por el terremoto de Northridge, 1994, en las juntas soldadas de las uniones vigas- columna. Véase: Blodgett, O (1995). *Notes on beam to column connections.* Steel Moment Frame Connection Advisory No. 3 Report No. SAC 95-01. SAC Joint Venture, Sacramento. El uso del Círculo de Mohr para explicar la pérdida de ductilidad en las conexiones soldadas puede verse en **36302** *Detalles estructurales para incrementar la ductilidad de las conexiones y* **36304** *Conexiones soldadas,* por O. Blodgett y D. Miller.

Los citados documentos se han insertado como *objetos* en este texto Word, por lo que es necesario hacer click en las páginas siguientes para que aparezca en la barra de herramientas el icono de descarga PDF y poder abrirlos.

Structural Details To Increase Ductility of Connections

OMER W. BLODGETT

Materials used in steel structures are increasingly becoming thicker and heavier. A greater chance of cracking during welding of beams to columns, for example, has resulted due to increased thickness of material. With weld shrinkage restrained in the thickness, width, and length, triaxial stresses develop that may inhibit the ability of steel to exhibit ductility. This paper will try to explain why these cracks may occur and what can be done to help prevent them by expanding on information presented in the AISC Supplement No. 1 (LRFD) or No. 2 (ASD).

We will first consider the pulling of a simple tensile specimen, to find out what conditions cause this ductile behavior. Then we will find out why this behavior goes from ductile to brittle when triaxial tension is applied. Finally, we will see what conditions under triaxial stresses the ductility can be restored.

This information is then applied to the practical question of how wide the weld access hole in the web of a connection should be to avoid brittle behavior.

In Fig. 1a the member is unstressed and the atoms are spaced the proper amount.

In Fig. 1b, a tensile stress is applied and the atoms move apart elastically in the direction of the stress. If the stress is removed, the atoms will move back into their proper positions as in Fig. 1a.

In Fig. 1c a compressive stress is applied and the atoms move together elastically in the direction of the stress. Again, if the stress is removed, the atoms will move back into their initial proper positions, as in Fig. 1a.

In both tension and compression, if the applied stress does not exceed the yield strength σ_y, the action is elastic and the member will come back to the initial dimensions when the stress is removed.

In both cases the energy stored in the stressed member is elastic energy. Examples would be a wound up clock, a structural member when stressed, etc.

If, however, as in Fig. 1d, the member is subjected to a shear stress that exceeds the critical value $\tau_c = ½\sigma_y$, then a permanent sliding action occurs along a plane between atoms which will not be recovered when the stress is removed.

Omer W. Blodgett is with The Lincoln Electric Company, Cleveland, OH.

This is *plastic strain* and results in energy being absorbed. In Fig. 2a, the member is subjected to a tensile stress σ under the yield strength σ_y. As in Fig. 1b, this results in elastic strain and is recoverable when the stress is removed. Notice also in Fig. 2a that a shear stress occurs which has a maximum value of $\tau = ½\sigma$ on a plane at 45°, with the axis of the applied tensile stress. If the applied stress σ is increased to a value of σ_y, the

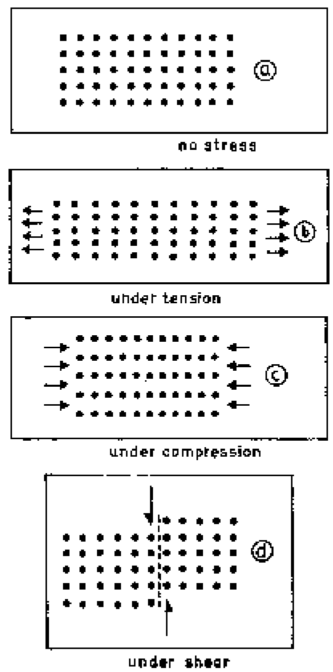


Figure 1

steelwise

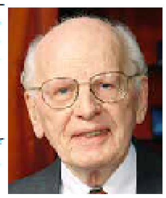
Practical advice from a master of weld design.

BLODGETT'S TREASURES

BY ERIN CRISTE

IF YOU'VE EVER DESIGNED a structural weld, you've likely heard of Omer W. Blodgett. His book *Design of Welded Structures* remains a go-to reference even though it dates back more than 40 years. But while you may know his name, you might not know how Mr. Blodgett came to be the face of welding.

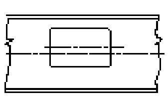
Blodgett first started learning to weld on his grandfather's Lincoln welder at the age of 10, which he says began his life's journey of learning and teaching welding principles. (Much of this is captured in an interview that is posted on AISC's Podcasts page at www.aisc.org/content.aspx?id=25892; scroll down to Episode 9.)

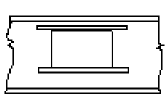


Blodgett is known for his ability to distill complex concepts into simple summaries. He also has coined many memorable sayings that are easily transferred from one generation to another. Here, we've presented a brief summary of some of the key points pulled from his books (particularly *Design of Welded Structures*), papers, articles and lectures.

Don't design with your heart.

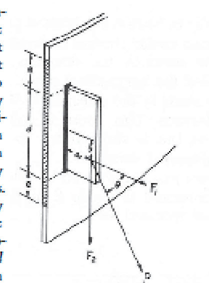
Blodgett has said, "It's OK to fall in love with your heart. But, when it comes to making engineering decisions, don't design with your heart." His point is that there are a variety of things that may intuitively seem to be correct, but analysis might lead to another answer. Take web penetrations or openings, for example. The "heart's" first reaction to any opening or reduction in area is to add reinforcing. While reinforcing might be necessary in some cases, it is not needed in all cases. And in cases where it is needed, how do you determine the reinforcing?





AISC *Steel Design Guide 2: Design of Steel and Composite Beams with Web Openings* provides guidance for compact wide-flange beams. For non-compact beams, Section 4.7 of Blodgett's *Design of Welded Structures* provides guidance on designing beams and girders with web openings using first principles of engineering mechanics to check web shear, web buckling and Vierendeel bending. Next time you have a project requiring an opening or want to see what effect a reduction in area of the web has on your section, don't design with your heart; use some analysis to see if reinforcement is required, using the procedures in AISC *Design Guide 2* or as outlined by Blodgett.

Provide a path for the load to enter into the member that lies parallel.



A typical oversight when designing welded connections is the failure to provide a proper load path so that a transverse force can enter that part of the member that lies parallel to the force. The flexibility afforded by the welding process permits materials to be configured and connected in a variety of ways—including ways in which the loads cannot be properly transferred between the members. While this principle applies to many situations, one common occurrence is in the design of hangers and supports. Section 6.6 of *Design of Welded Structures* provides guidance on designing such weldments.

One must account for a proper load path and consider the orientation of the weld to the force to minimize mistakes in real-world applications. Providing a proper load path can be more apparent when the section and the joints are square. However, when designing a curved section (such as pipe and supports/hangers) it might not be as obvious. In this case and many others, it is important to think of how the force will transfer through the weldment when selecting its details and configuration. One must always provide a proper load path so the force can enter into the section that lies parallel. There are many examples and discussion throughout the Blodgett resources, such as in Section 6.6 on hangers.

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Blodgett, O.W. and Miller, D.K. “Welded Connections”
Structural Engineering Handbook
Ed. Chen Wai-Fah
Boca Raton: CRC Press LLC, 1999