CANADIAN STEEL FRAMING:
A Quantum Leap

In Canada, officials are including a new concept—LSD—in their steel framing standard.

Canada is gearing up for a quantum leap in steel framing. The Canadians are busy promulgating a new standard that will promote more sophisticated design and economies in steel-framed buildings.

Included in the new standard, which was adopted in 1974, is a concept called limit states design (LSD). This concept is not yet included in U.S. specifications.

Basically, the method offers a comprehensive approach to analyzing statistical reliability variations for loads on a structure as well as its resistance or strength.

From a practical standpoint, it represents the elimination of the traditional safety factor for each member which is believed to be unrealistically high in many cases when combined with other members.

The new safety margins have been developed from statistical probability analyses of the loads and strengths of materials.

Consequently, LSD's major benefit will lie in avoiding most overly conservative load situations that are inherent in current design methods.

In the United States, engineers are reportedly completing work on the development of a similar concept, called load and resistance factor design (LRFD). But the U.S. concept is well behind the Canadians in the specifying process, reflecting apparently the need for so many more groups in this country to review the standard for consensus.

Under the Canadian concept, different load and resistance factors are applied according to their variability when acting together. This permits flexibility when considering different structural combinations for the different loads. Such an approach differs markedly from the traditional method of designing to allowable stress by utilizing a specific overall safety factor for each element.

LSD also involves resistance factors which consider statistical variations in material properties, dimensional tolerances and other sources of scatter in predicting structural resistance.

A reliability model ties the entire process together and it is this statistical probability expression that allows the author of a design specification to deal with limit states in establishing the load and resistance factors on a consistent basis.

Massachusetts Institute of Technology professor C. A. Cornell was primarily responsible for developing the model which relates all elements of the design approach to one another.

There are two different criteria in LSD's limit states. One, strength limit states, deal with the maximum capacity of a member under extreme loads, expected very infrequently in a building's lifetime. These loads would reach a member's plastic strength and affect a structure's stability or cause a member to fracture.

The second, serviceability limit states, concern the response of a structure to frequently encountered loads, such as those that involve deflection or drift.

The use of probability theory in the development of load factors carries the Canadian LSD standard a step farther than its original counterpart in Europe where it has been used for the past 10 years.

Now designers can combine their customary "experienced hunch" method with load factors, historical evidence and computerization.

The benefits to the steel-framing industry provided by the LSD means that better, more reliable structures can be built for less money. Where the old standards dictated different allowable

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Many profitable contractors include columns headed Bid No. 1 and Bid No. 2 in their summary. The second column is used for adjusted price extensions resulting from discounting quotes, inserting alternate items, corrections, etc. This feature permits bid preparation using the original facts and then varying the facts for management judgement.

Another control device is the “rule-of-thumb” check. Based on management’s general cost experience for different types of construction, rule-of-thumb prices can provide a rough estimate of the total job costs. If a significant difference exists between these checks and the accumulated amount of the bid, figures are challenged and cost justifications are required.

Upon acceptance of the cost estimate, the overhead and profit to be added to the final bid are carefully judged. How does the profitable contractor determine his margin of profit? Does he consistently add on the same percentage, or will it vary on each job bid?

Factors considered include the level of risk, job size and length, competition and current workload. A contractor’s percentage of profit, therefore, should reflect careful evaluation of the varying conditions of each job.

**Conclusion**

The estimate-bid process is as important as the build function—and probably more important. Weakness or strength in this process can cost or generate as many, if not more, profit dollars than comparable attention to the installation function.

Top management’s full attention and participation in this activity is a necessity. In today’s economy, adequate control of estimate-bid has become fundamental to a contractor’s profitability.

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stresses for bending, depending on the shape of the member, the new concept permits the use of the cross-sections’ properties in getting the load a member can carry.

The U.S. LRFD concept is a spin-off to load factor design for steel bridges except that it includes resistance factors while the bridge version does not.

The American Iron and Steel Institute is sponsoring research on LRFD.

Research is reportedly just about complete and an advisory task force is going over two studies by structural engineering firms that designed buildings using present design standards and then designed them using LRFD.

Hansell says his report will be turned over to the American Institute of Steel Construction within a year.