

## 2.11 COMPARATIVE COST AND MASS

The cost and mass comparison for various types of steel must ultimately be made by evaluating alternative designs for a specific component. However, some general guidelines can be applied to determine the potential advantages of high strength steel. For example, in those cases where the yield strength can be fully utilized, the required thickness can be reduced by using appropriate formulas for tensile, flexural, torsional, or combined stress.

In many cases it is not possible to take full advantage of the high yield strength materials. The geometry of the component and the type of applied load may dictate a failure mode that is governed to some degree by stiffness. In some cases the forming and fabricating constraints must be evaluated against the material properties to determine whether the desired design can be produced, or how closely it can be approximated.

Where stiffness governs the design, there is a tendency to conclude that high strength steels will offer no advantage because all steels have the same modulus of elasticity. It may, however, be advantageous to modify the geometry of the component somewhat to increase the stiffness. For example, deep thin walled sections may tend to fail by buckling, either locally (such as in the web or flange of a section) or across the entire section (such as a long column in compression). In the latter case, a deeper section may be beneficial. Local buckling can be avoided or delayed by designing one or more stiffeners into critical areas to raise the stress level before buckling occurs and allow the design to take advantage of a higher yield strength material. Section 3.1 includes quantified design data for carbon steel that will assist the designer in identifying areas of a thin walled member that are subject to local buckling, and where increasing the local stiffness is beneficial.

Designs using stainless steels are currently governed by the ASCE specifications<sup>1</sup> and are too extensive to be covered in this manual. However, previous comments concerning designs with higher strength steels are also appropriate for stainless steels, except that consideration should be given to the anisotropy and low proportional limit.

Many factors affect overall component cost such as corrosion resistance, component life, and subsequent processing operations. Material costs, which can vary widely, are only one factor in the overall cost. A more expensive material that meets performance requirements and requires less processing may generate lower overall cost than a less expensive material. General cost guidelines can be offered to assist the designer in these tradeoffs that typify the initial stages of design.

[Table 2.11-1](#) gives approximate comparative cost data for twelve types of steel that can be used to advantage by the automotive designer.

**Table 2.11-1** Approximate relative costs of various sheet steels  
(Based on popular widths and thicknesses)

| Type                           | Approximate Relative Cost |
|--------------------------------|---------------------------|
| Hot Rolled Carbon              | 0.80                      |
| Cold Rolled Carbon             | 1.00                      |
| Bake Hardenable                | 1.10                      |
| Hot Dipped Galvanized          | 1.12                      |
| Aluminized                     | 1.21                      |
| Electroalvanized               | 1.35                      |
| HSLA                           | 1.15                      |
| Dual Phase                     | 1.40                      |
| Martensitic                    | 1.50                      |
| Aluminum Sheet Type 5052       | 4.8                       |
| Austenitic Stainless Type 304  | 5.7*                      |
| Ferritic Stainless Type 409    | 2.6*                      |
| Martensitic Stainless Type 410 | 2.8*                      |
| PH Stainless 17-4              | 9.0*                      |

\* Stainless steel costs are strongly influenced by cost of expensive alloys such as chromium and nickel, which can cause more price variability than with carbon steels.

Although sheet steel products are sold on the basis of mass, there are specific points at which there are step increases in the cost per unit of mass. These points relate to thickness, width of original blank, degree of formability required, strength level required for structural function, and the type and amount of corrosion protection required. The step points vary among steel suppliers and cannot be easily identified. However, they are generally based on productivity. For example:

1. More production time per pound is required to produce thinner gauges.
2. When widths are narrow, less steel is processed through a production line during a given time.
3. Greater degrees of formability or higher strength levels require more expensive grades of steel.
4. Any increase in alloy content results in a higher cost product.
5. Greater degrees of corrosion protection also increase the cost of steel.