# CHAPTER 6

# SLINGS

Slings require special attention because they are almost always subjected to severe wear, abrasion, impact loading, crushing, kinking and overloading. They also merit special attention because seemingly insignificant changes in sling angle drastically affect the loading. When using slings exercise extreme caution because you are going to be developing unknown loads, under less than ideal circumstances, in less than perfect equipment.

Failure to provide blocking or protective pads will permit sharp corners to cut slings. Pulling slings from under loads will result in abrasion and kinking. Dropping loads on slings or running equipment over them will cause crushing. Sudden starts and stops when lifting loads will increase the stresses in them. Also, improper storage will result in deterioration.

Because of the severe service expected of slings, errors in determining load weight, and the effect of sling angle on the loading, it is recommended that all safe working loads be based on a factor of safety of at least 5:1.

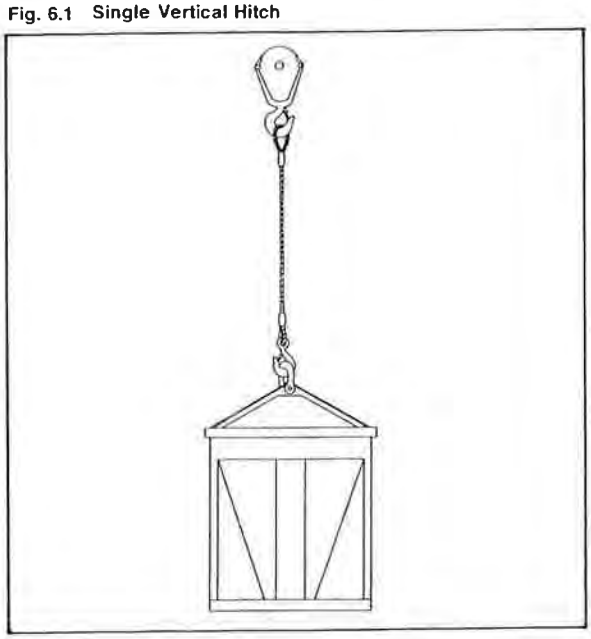
## SLING CONFIGURATIONS:

The term "sling" includes a wide variety of configurations for all fibre ropes, wire ropes, chains and webs. The most commonly used types in construction rigging will be considered here because improper application can affect the safety of the lift.

**Single Vertical Hitch** (Fig. 6.1) is a method of supporting a load by a single vertical part or leg of the sling. The total weight of the load is carried by a single leg, the angle of the lift is 90° and the weight of the load can equal the maximum safe working load of the sling and fittings. The end fittings of the sling can vary but thimbles should be used in the eyes. Also, the eye splices on wire ropes should be Mechanical-Flemish Splices for best security. This sling configuration must not be used for lifting loose material, lengthy material or anything that will be difficult to balance. Use them only on items equipped with lifting eye bolts or shackles such as concrete buckets. They provide absolutely no control over the load because they permit rotation.

**Bridle Hitch** (Fig. 6.2, 6.3, 6.4) Two, three or four single hitches can be used together to form a bridle hitch for hoisting an object that has the necessary lifting lugs or attachments. They can be used with a wide assortment of end fittings. They provide excellent load stability when the load is distributed equally among the legs, when the hook is directly over the center of gravity of the load and the load is raised level. In order to distribute the load equally it may be necessary to adjust the leg lengths with turnbuckles. The use of a bridle sling requires that the sling angles be carefully determined to ensure that the individual legs are not overloaded.

Fig. 6.1 Single Vertical Hitch



Unless the load is flexible, it is wrong to assume that a 3 or 4 leg hitch will safely lift a load equal to the safe load on one leg multiplied by the number of legs because there is no way of knowing that each leg is carrying its share of the load. With slings having more than 2 legs and a rigid load, it is possible for two of the legs to take practically the full load while the others only balance it.

**Single Basket Hitch** (Fig. 6.5) is a method of supporting a load by hooking one end of a sling to a hook, wrapping it around the load and securing the other end to the hook. It cannot be used on any load that is difficult to balance because the load can tilt and slip out of the sling. On loads having inherent stabilizing characteristics the load on the sling will be automatically equalized with each leg supporting half the load. Ensure that the load does not

Fig. 6.2 2-Leg Bridle Hitches

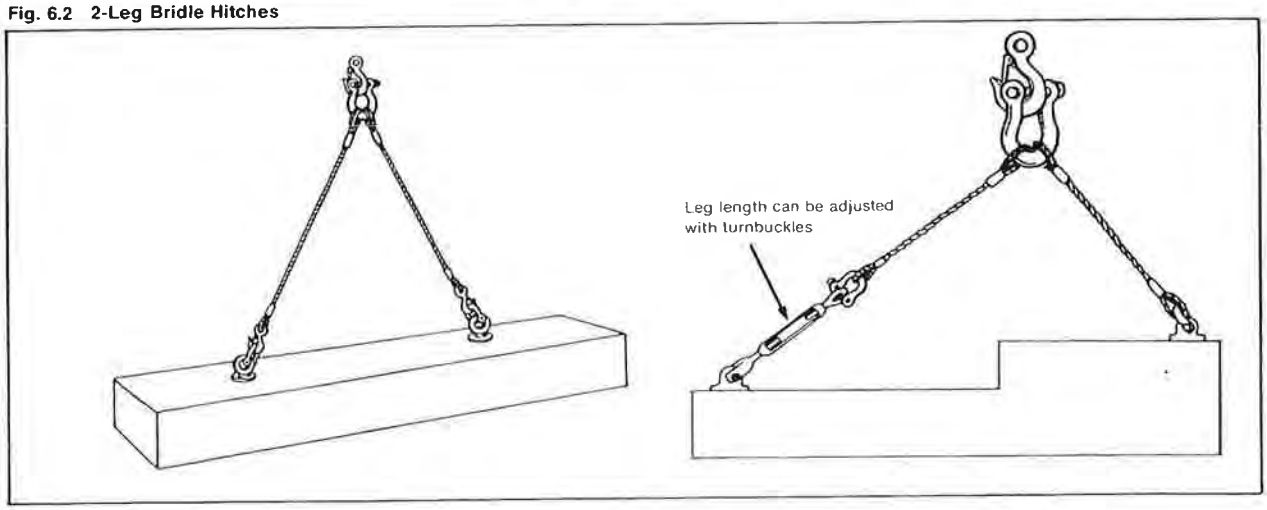
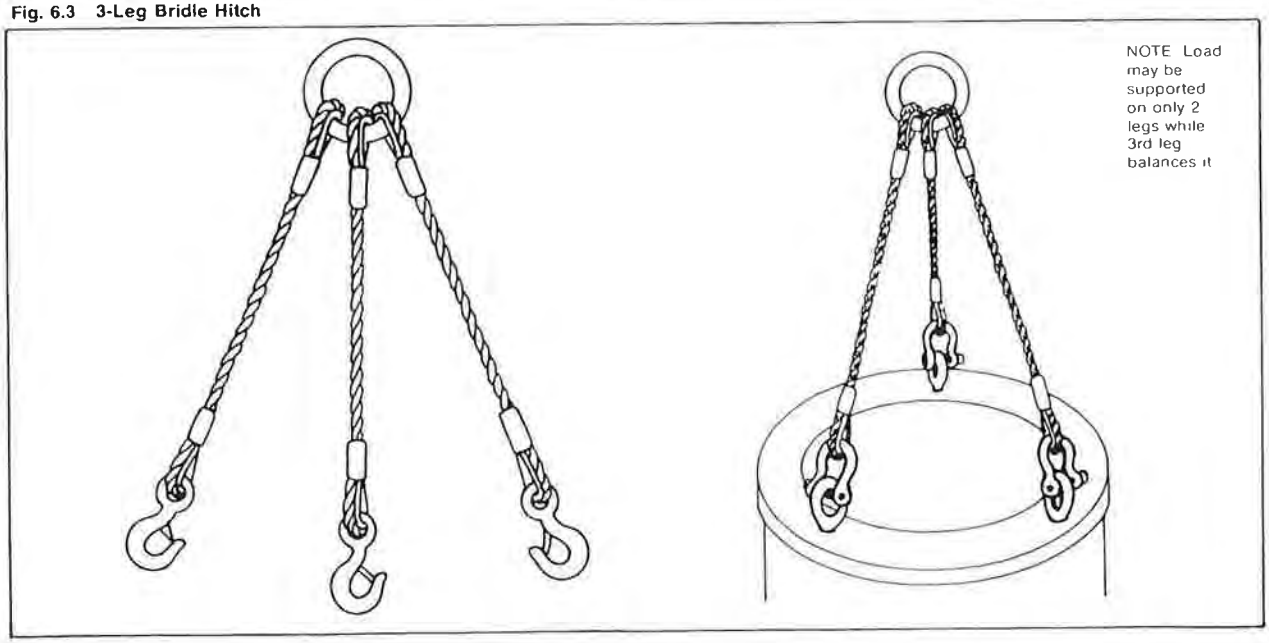



Fig. 6.3 3-Leg Bridle Hitch



turn or slide along the rope during a lift because both the load and rope will become damaged.

**Double Basket Hitch** (Fig. 6.6) consists of two single basket hitches passed under the load. They must be placed under the load so that it is properly balanced. The legs of the hitches must be kept far enough apart to provide balance but not so far apart that excessive angles are developed or to create a tendency for the legs to be pulled in toward the center. On smooth surfaces, both sides of the hitches should be snubbed against a step or change of contour to prevent the rope from slipping as load is applied. The angle between the load and the sling should be approximately 60° or greater to avoid slippage.

Fig. 6.4 4-Leg Bridle Hitch

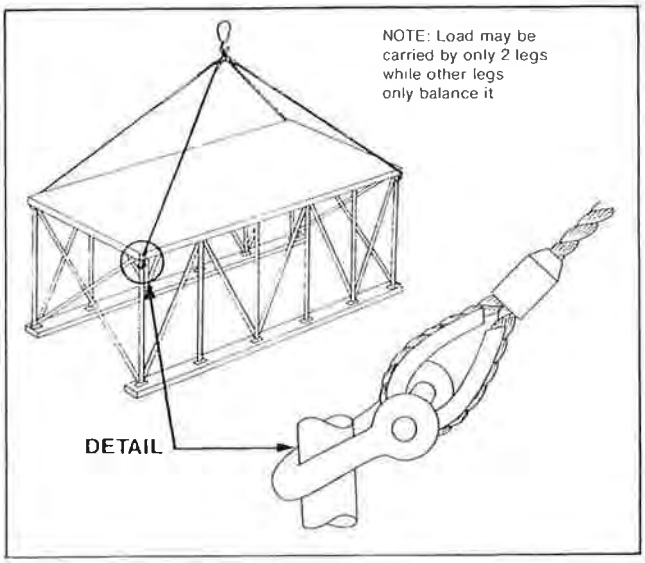



Fig. 6.5 Single Basket Hitch

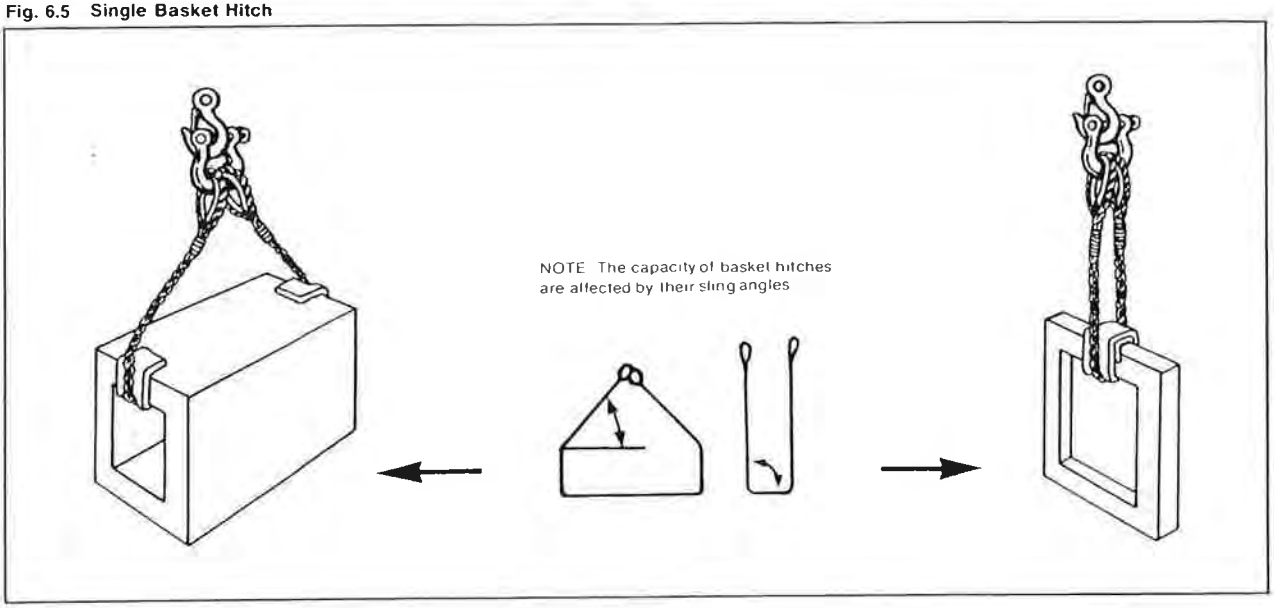



Fig. 6.6 Double Basket Hitches

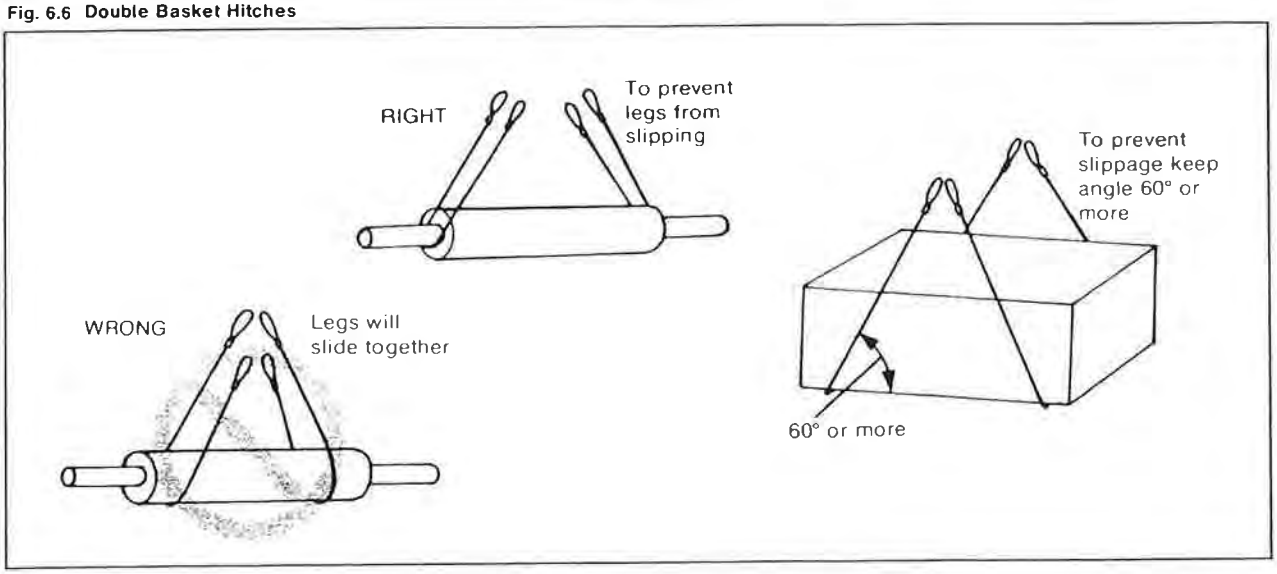


**Fig. 6.7 Double Wrap Basket Hitch**

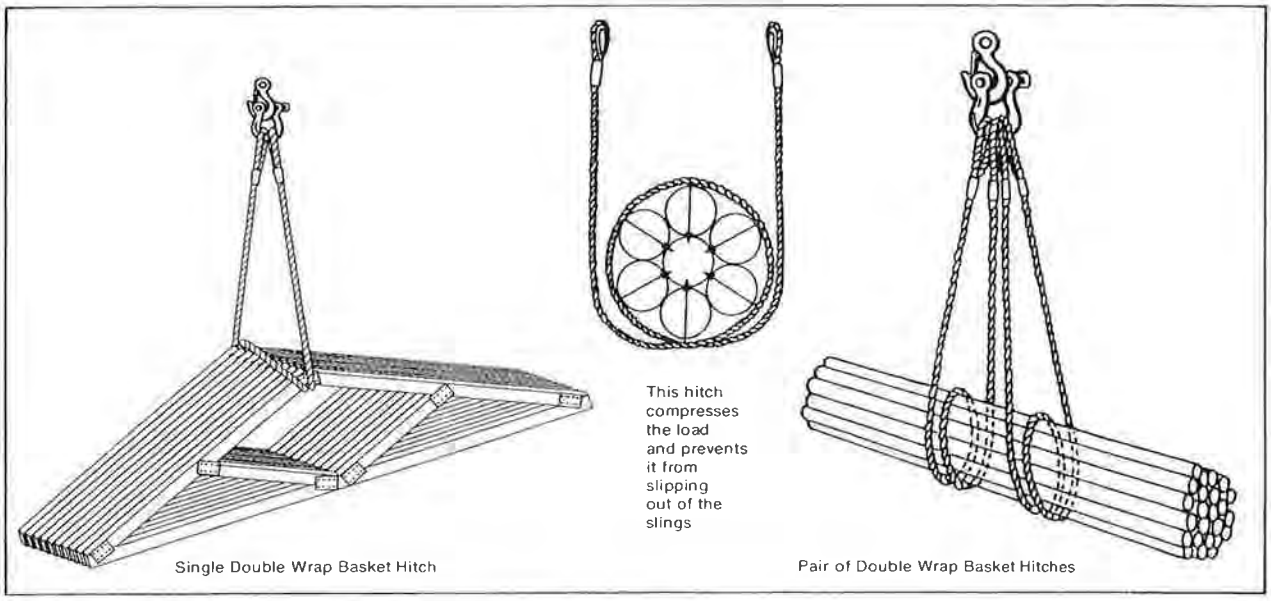
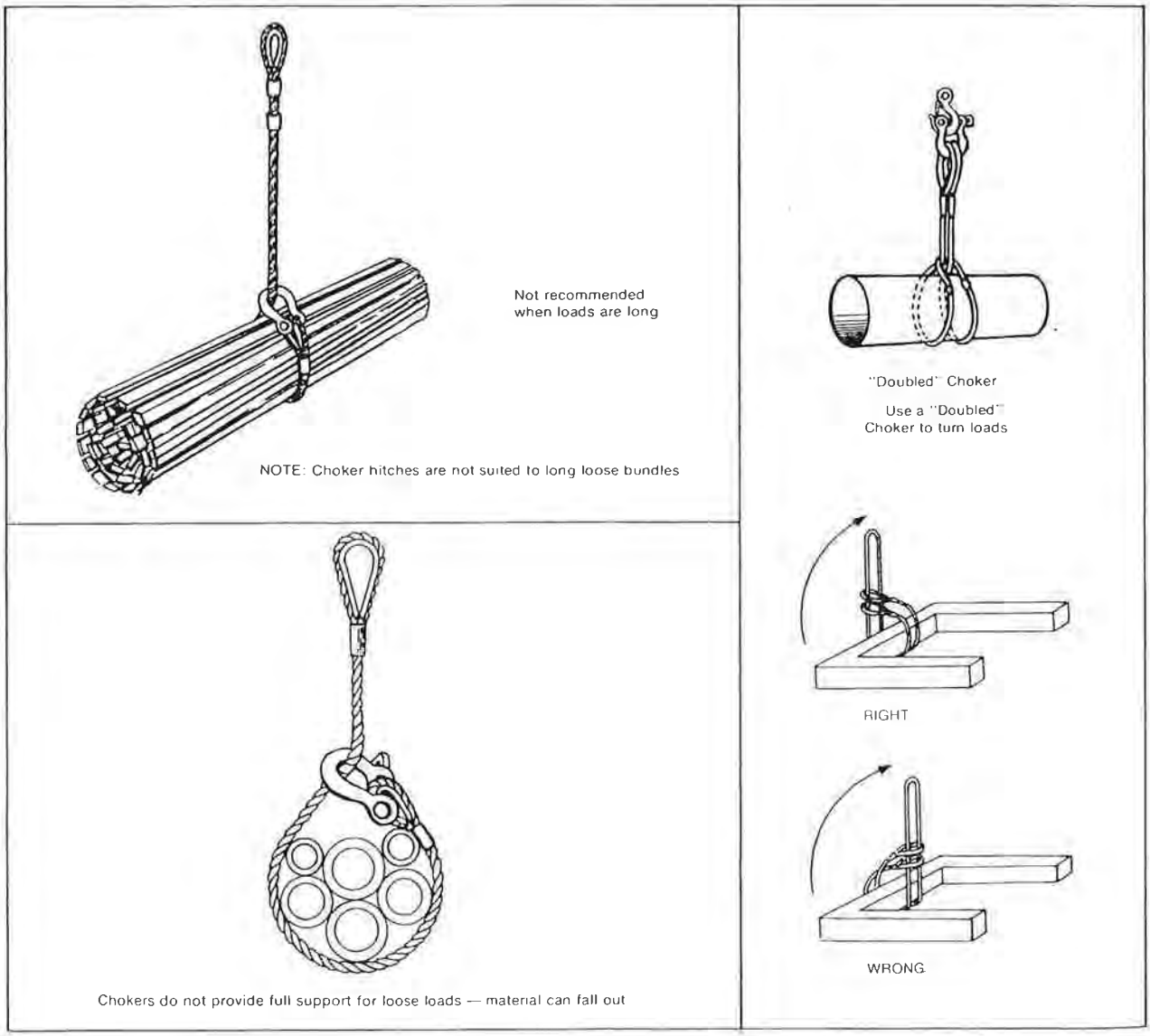



**Fig. 6.8 Single Choker Hitches**



**Double Wrap Basket Hitch** (Fig. 6.7) is a basket hitch that is wrapped completely around the load rather than just supporting as does the ordinary basket hitch. The double wrap basket hitch can be used in pairs like the double basket hitch. This method is excellent for handling loose material, pipe, rod or smooth cylindrical loads because the rope or chain exerts a full 360° contact with the load and tends to draw it together.

**Single Choker Hitch** (Fig. 6.8) forms a noose in the rope that tightens as the load is lifted. It does not provide full 360° contact with the load, however, and because of this it should not be used to lift loose bundles from which material can fall or loads that are difficult to balance. The single choker can also be doubled up (not to be confused with double choker hitch) as shown to provide twice the capacity or to turn a load. When it is necessary to turn a load, the choker is made by placing both eyes of the sling on top of the load with the eyes pointing in the direction opposite to the direction of turn. The center of the sling is passed around the load, through both eyes and up to the hook. This hitch provides complete control over the load during the entire turning operation, and the load automatically equalizes between the two supporting legs of the sling. Because the load is turned into a tight sling, there is no movement between the load and the sling. If it is incorrectly made and the two eyes are placed on the crane hook — the supporting legs of the sling may not be equal in length and the load may be imposed on one leg only.

**Double Choker Hitch** (Fig. 6.9) consists of two single chokers attached to the load and spread to provide load stability. They, like the single choker, do not completely grip the load but because the load is less likely to tip they are better suited for handling loose bundles, pipes, rods, etc.

**Fig. 6.9 Double Choker Hitches**

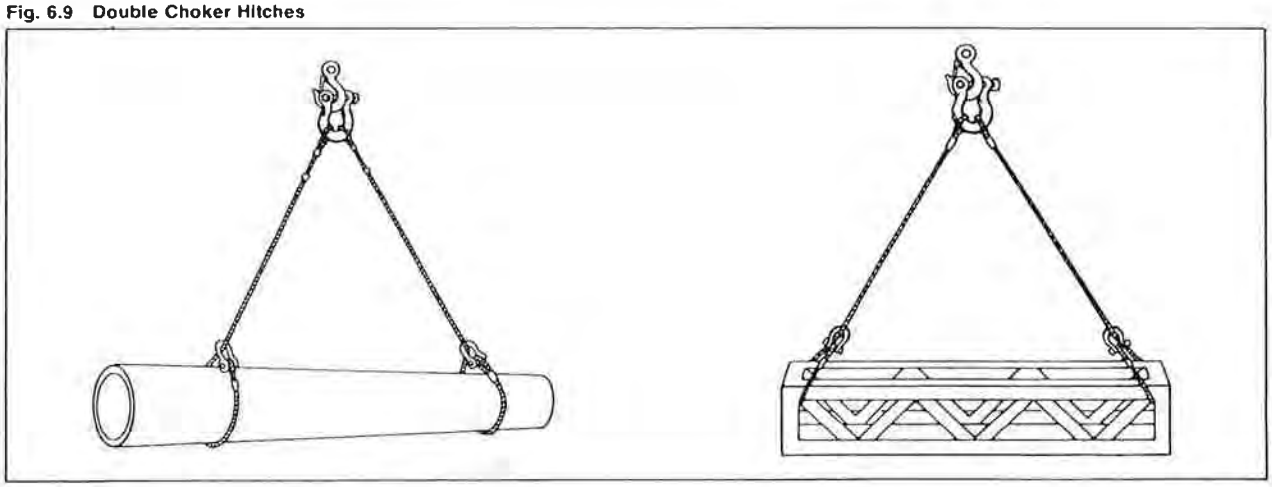


**Fig. 6.10 Double Wrap Choker Hitches**

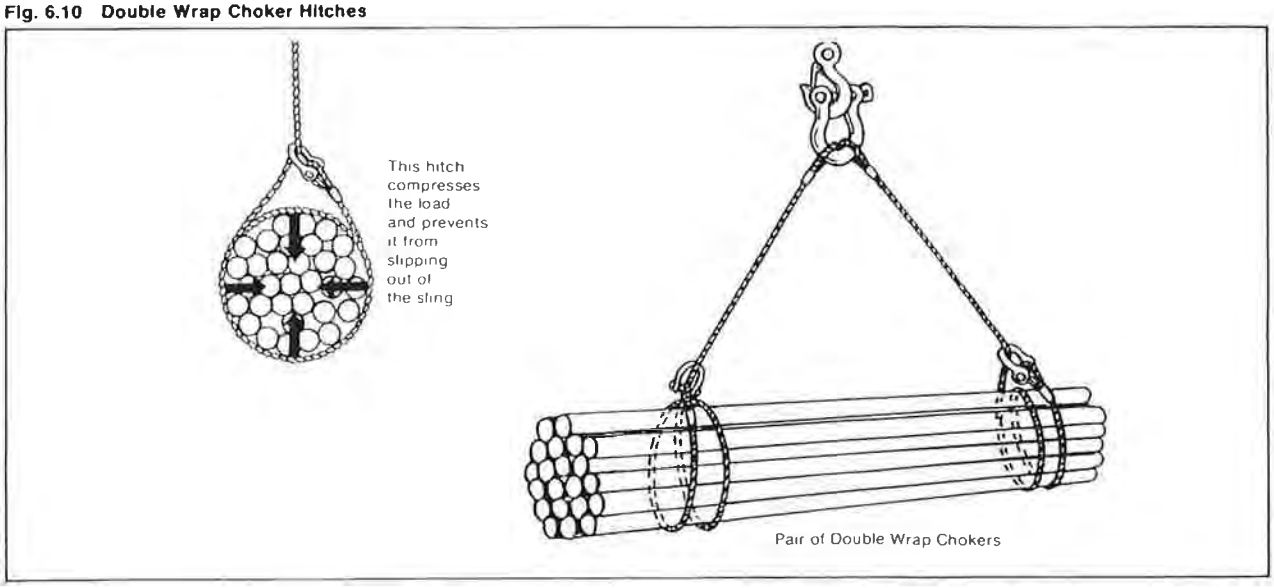


**Fig. 6.11 Endless Slings or Grommet Slings**

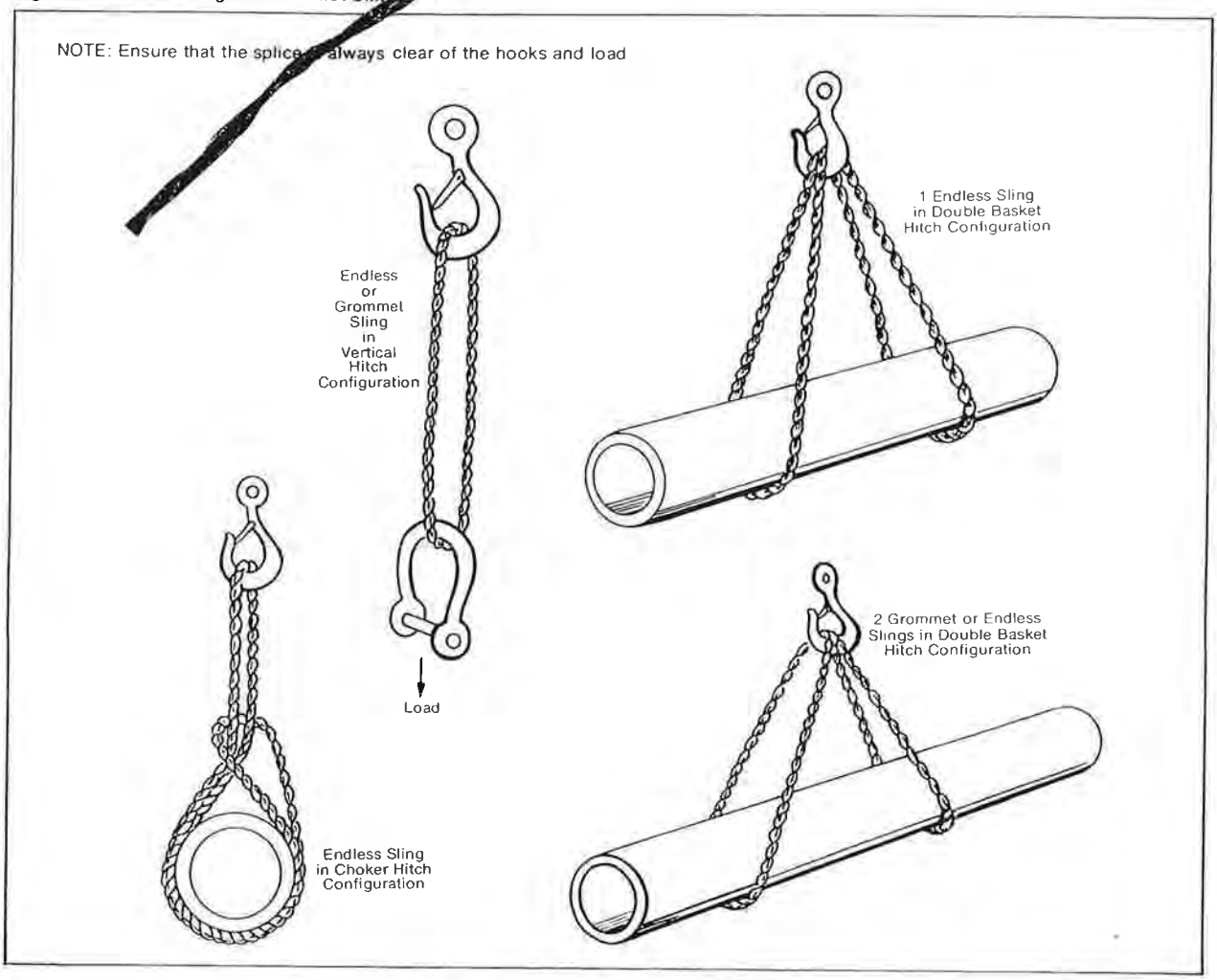
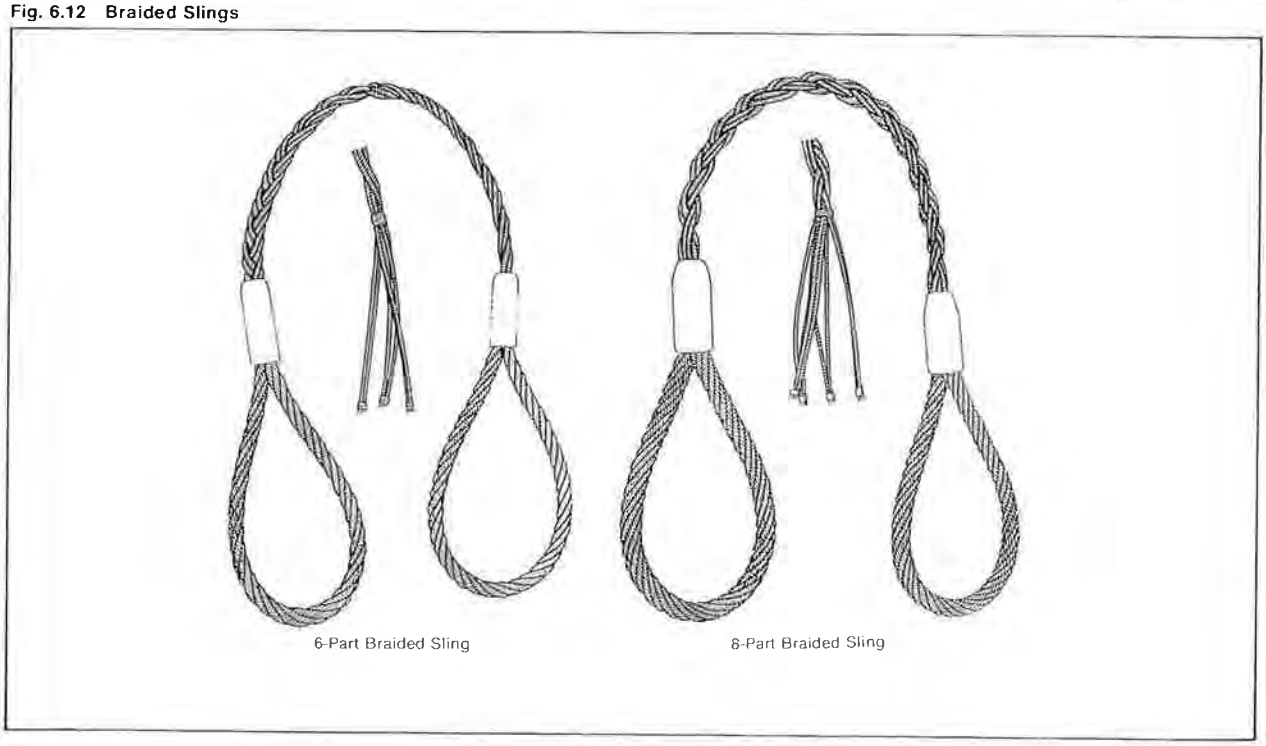



**Fig. 6.12 Braided Slings**



**Double Wrap Choker Hitch** (Fig. 6.10) is one in which the rope or chain is wrapped completely around the load before being hooked into the vertical part of the sling. This hitch is in full contact with the load and tends to draw it tightly together. It can be used either singly on short, easily balanced loads or in pairs on longer loads.

**Endless Slings or Grommet Slings** (Fig. 6.11) are endless ropes that are made from one strand of a rope laid or twisted around itself on each successive loop. There is only one tuck in the entire circumference where the two ends enter the rope. These slings can be used in a number of configurations, as vertical hitches, basket hitches, choker hitches and all combinations of these basic configurations. They are very flexible but tend to wear and deteriorate more rapidly than the other slings because they are not normally equipped with fittings and thus are deformed when bent over hooks and bear against themselves at the bight.

**Braided Slings** (Fig. 6.12) are fabricated from usually 6 or 8 small diameter ropes braided together to form a single rope that provides a large bearing surface, tremendous strength and flexibility in all directions. They are very easy to handle and almost impossible to kink. The braided sling can be used in all the standard configurations and combinations but is especially useful for basket hitches where low bearing pressure is desirable or where the bend is extremely sharp.

**SLING ANGLES:**

The rated capacity of any sling depends on its size, its configuration and the angles formed by the legs of the sling and the horizontal. A sling with two legs that is used to lift a 1000 pound object will have a 500 pound load in each leg when the sling angle is 90°. The load in each leg will increase as the angle is decreased and at 30° the load will be 1000 pounds in each leg. (Fig. 6.13)

If possible, keep the sling angles greater than 45°; sling angles approaching 30° should be considered extremely hazardous and avoided at all costs. The sharp increase in loading at low angles is clearly shown in Fig. 6.14.

Some load tables list sling angles as low as 15° but the use of any sling at an angle less than 30° is extremely dangerous. This is not only because of the high loads associated with them but because of the effect on the load of an error in sling angle measurement of as little as 5°. Table 6.1 illustrates the effect of a 5° error in sling angle measurement on the sling load.

You can see that there is almost a 50% error in the assumed load at the 15° sling angle. This illustrates how cautious you must be in not only ensuring the angle is greater than 45°, but the importance of measuring it accurately. The easiest and most accurate way to determine the angle is by measuring it with a large plywood measure graduated in degrees.

**SAFE WORKING LOADS:**

The remaining sections of this chapter contain many tables of safe working loads. It would be a very difficult task to remember all load, size and sling angle combinations, but the following rules of thumb work well for estimating the loads in the most common sling configurations.

Each of the rules of thumb for a given sling configuration, material and size, is based on the safe working load of the single vertical hitch of that sling. The efficiencies of whatever

**TABLE 6.1**

**EFFECT OF SLING ANGLE MEASUREMENT ERROR ON LOADS**

| Assumed Sling Angle | Assumed Load (Pounds Per Leg) | Actual Angle (is 5° Less Than Assumed Angle) | Actual Load (Pounds Per Leg) | Error % |
|---|---|---|---|---|
| 90° | 500 | 85° | 502 | 0.4 |
| 75° | 518 | 70° | 532 | 2.8 |
| 60° | 577 | 55° | 610 | 5.7 |
| 45° | 707 | 40° | 778 | 9.1 |
| 30° | 1,000 | 25° | 1,183 | 18.3 |
| 15° | 1,932 | 10° | 2,880 | 49.0 |

Fig. 6.13 Effect of Sling Angle on Sling Load

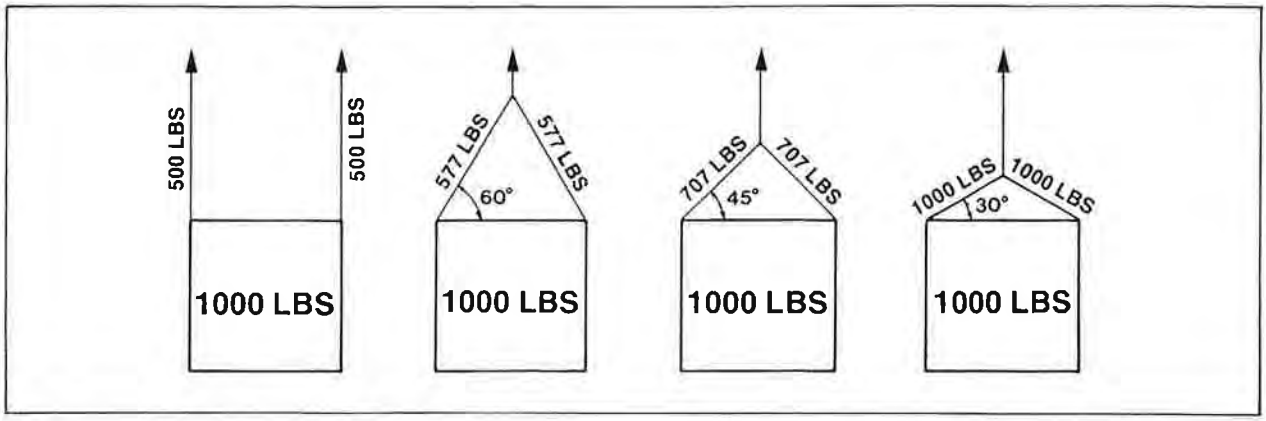
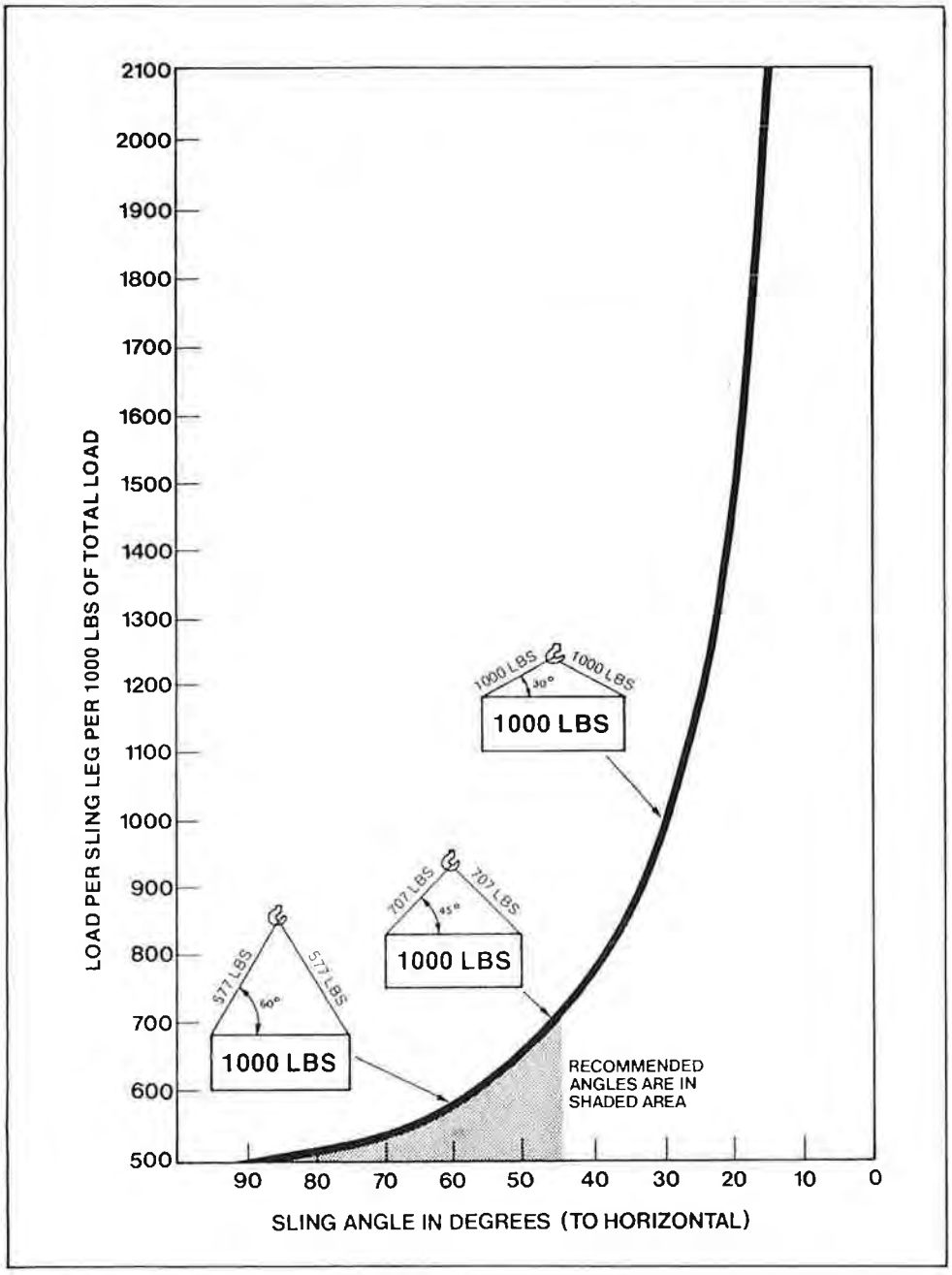



Fig. 6.14 Effect of Sling Angle on Sling Load



end fittings are used must also be considered to determine the capacity of the combination.

—**Bridle Hitches** (Figs. 6.15, 6.16, 6.17)
Measure the length of sling legs (= L) and the head room between hook and load (= H).

### 2-Leg Bridle Hitch

S.W.L. = S.W.L. (of single vertical hitch)
$= \frac{H}{L} \times 2$

### 3- and 4-Leg Bridle Hitches

S.W.L. = S.W.L. (of single vertical hitch)
$= \frac{H}{L} \times 2$

Generally, 4-leg bridle hitches should be rated as 2-leg hitches because there is no way of knowing that all four legs are sharing the load. It is possible for only two legs to carry the load while the third and fourth merely balance it.

**Fig. 6.15 Determination of Capacity of 2-Leg Bridle Hitches**

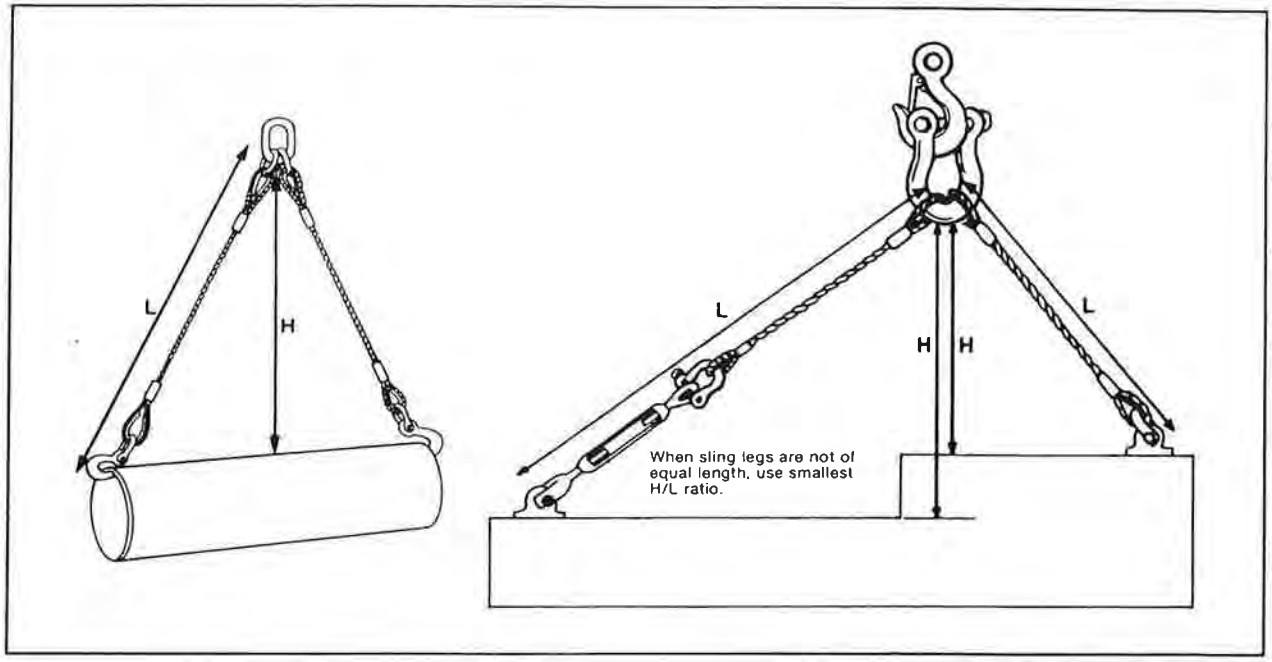



**Fig. 6.16 Determination of Capacity of 3-Leg Bridle Hitch**

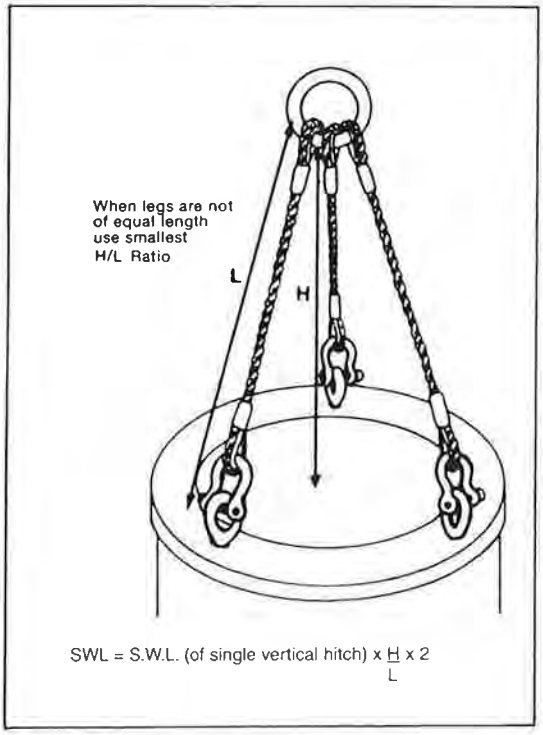



**Fig. 6.17 Determination of Capacity of 4-Leg Bridle Hitch**

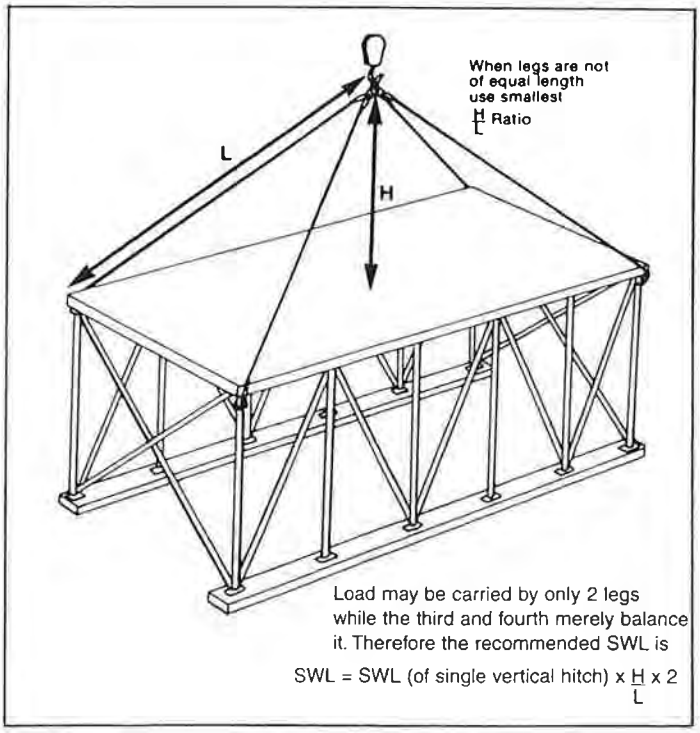


**Fig. 7.14 On a Rigid Object the Load Could Be Carried On Only 2 Legs or Sling While Other Legs Only Serve to Balance.**

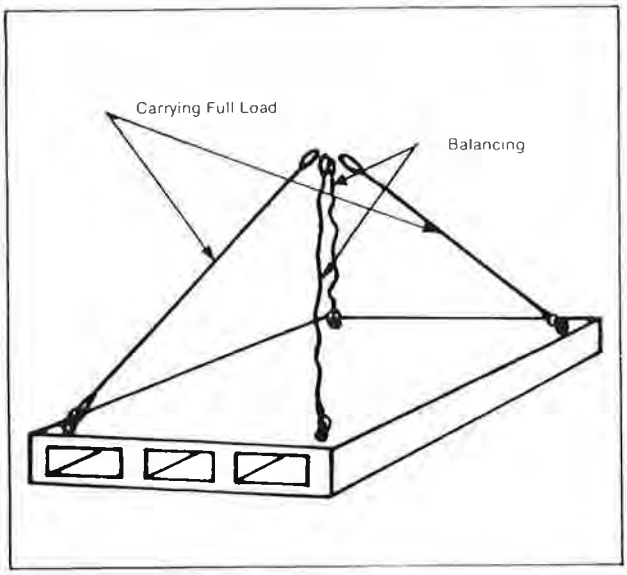



**Fig. 7.15 Know What the Load In Each Sling Leg will be Before the Lift is Made**

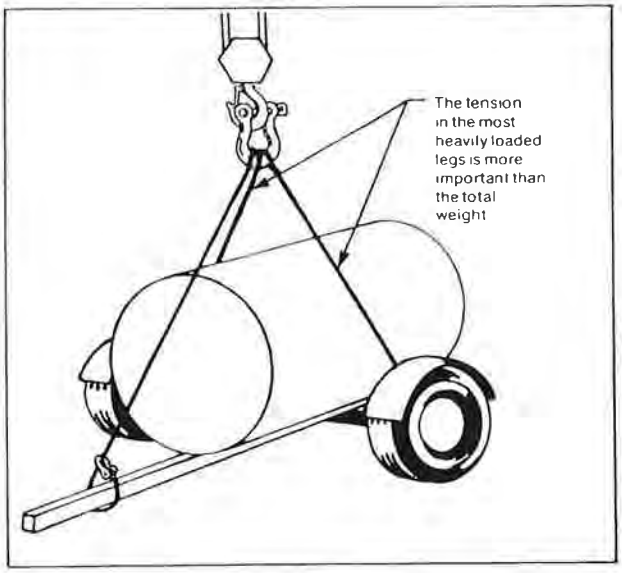



**Fig. 7.16**

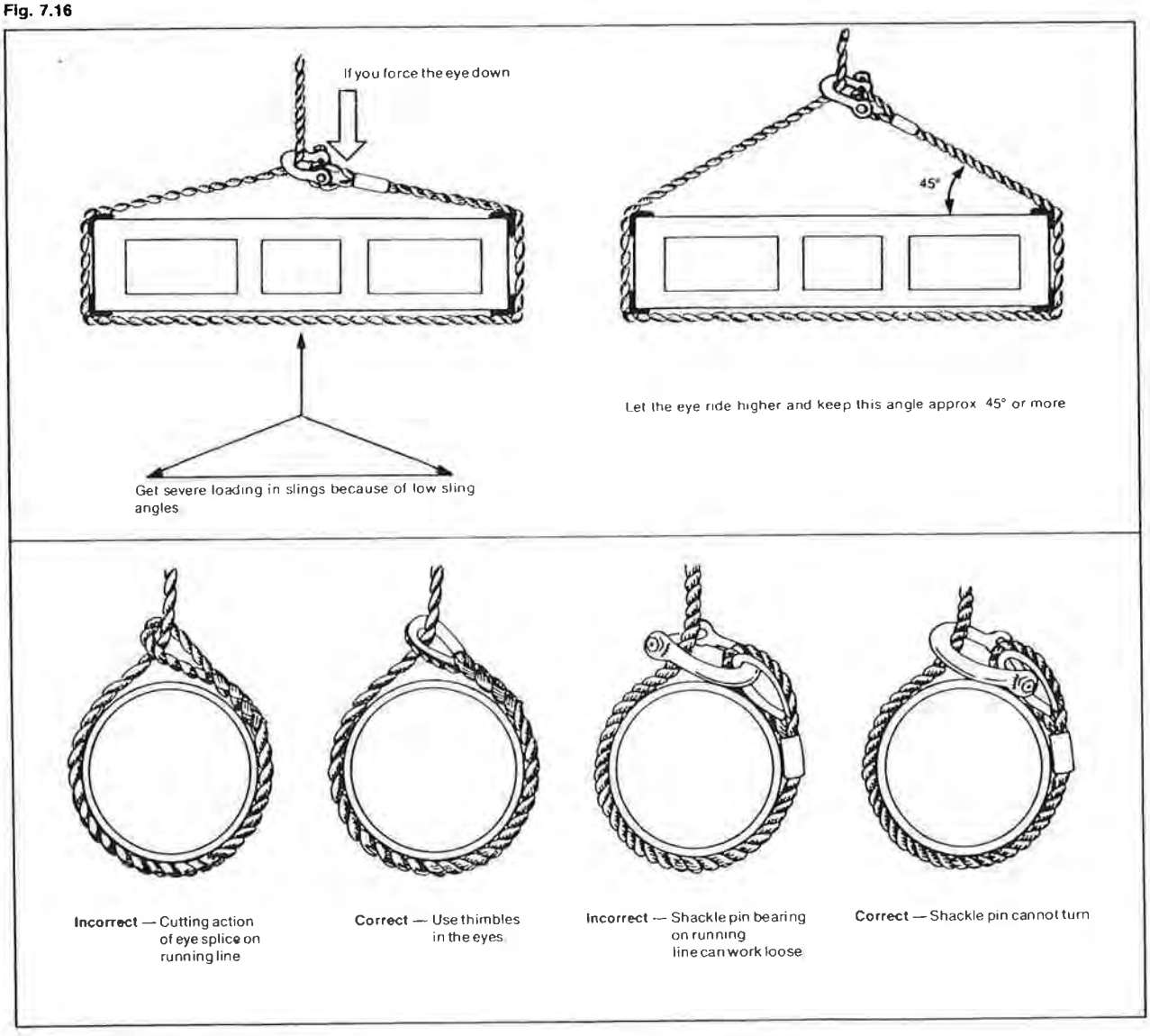


**Fig. 2.30 Effect of Knots, Bends and Hitches on Rope Strength**

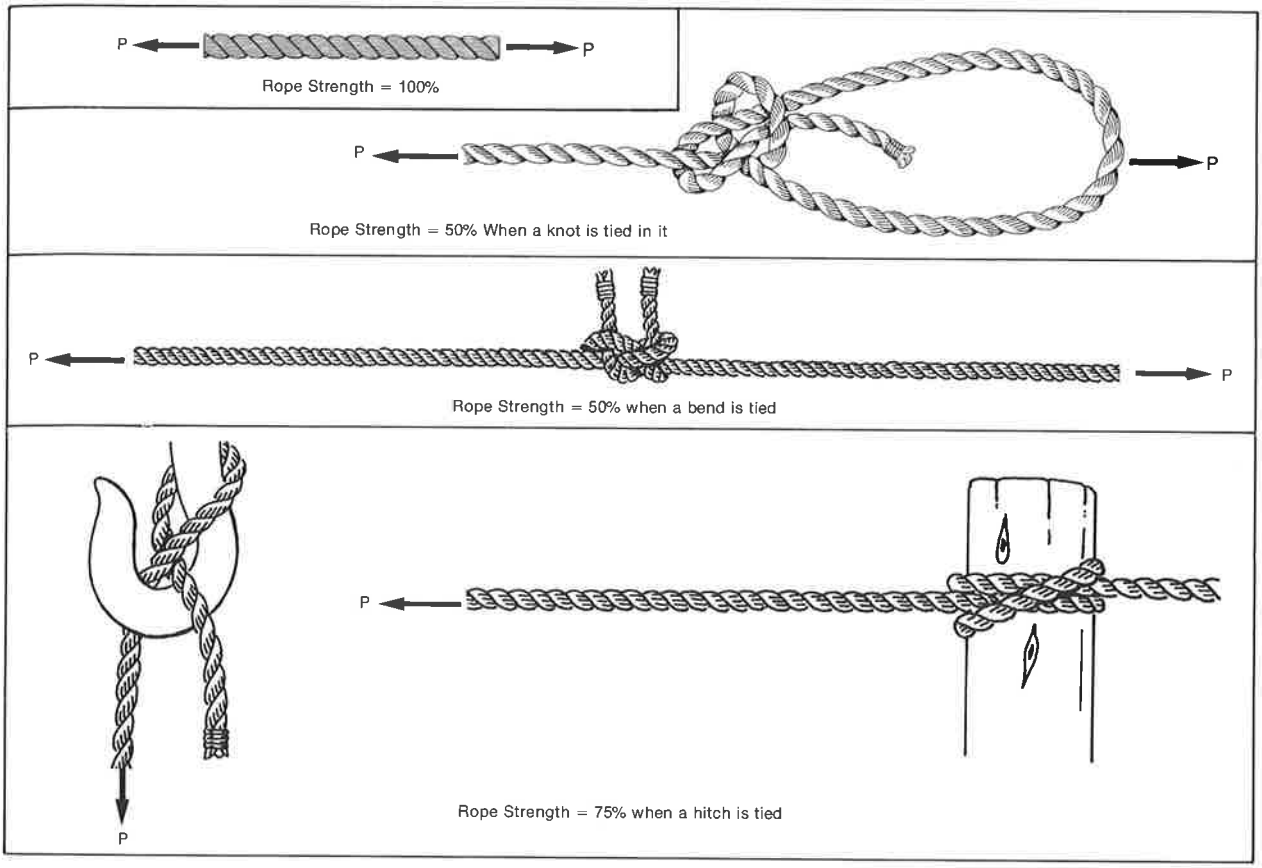



**Fig. 2.31 Capacity of 2 Ropes Looped Together**

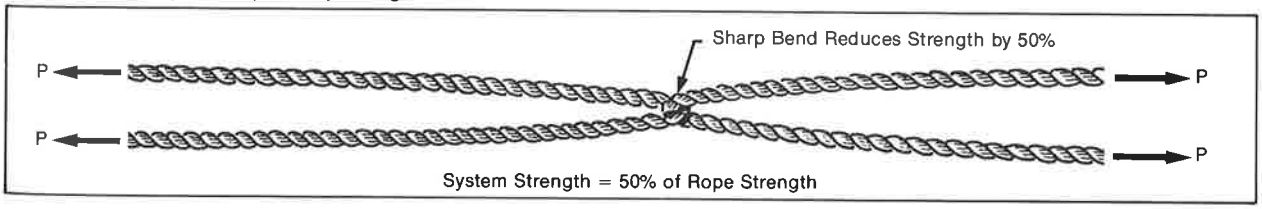



**Fig. 2.32 System Strength When a Series of Knots and Splices are Tied**

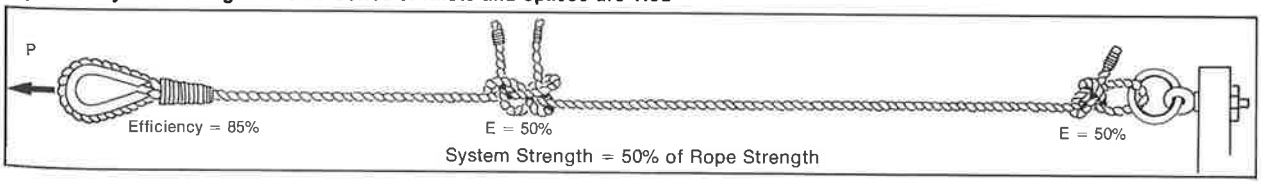



**Fig. 2.33 Blackwall Hitch**

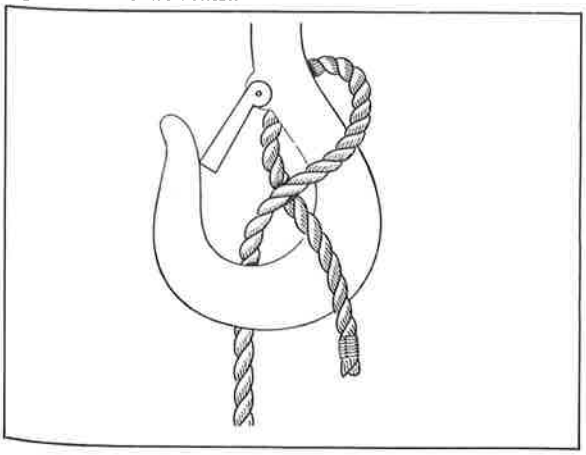


**Fig. 2.34 Double Blackwall Hitch**