

significant stiffening of the grids. The easiest way to keep a grid from torque is to maintain a level grid with even and synchronous loading. For this reason, it is not recommended that slip joints be used in the structural framework of suspension grids.

Load distribution among the primary grid suspension points should be balanced. It is much easier to maintain a balanced load distribution with only three primary suspension points, but four primary suspension points are more common. With four primary suspension points, at the very least, two of the points

should include a turnbuckle or another adjustable tension device in order to balance the load distribution in the grid.

#### Appropriate suspension means

The most common and practical means will accommodate almost every contingency and are as follows:

- **Wire rope:** Wire rope and wire-rope slings are the foundations of most suspension systems. Wire rope comes in a variety of types and styles to fit many specialty applications. The most common types of wire rope used in the loudspeaker rigging industry are 7×19GAC (galvanized

aircraft cable) for sizes up to 1/2 inch (13 mm) and 6×19IWRC (independent wire rope core) for sizes above 1/2 inch. The United States requires minimum strength standards, so it is a good idea to buy only wire rope that is manufactured within the United States.

Wire-rope slings can be made on site by using U-bolt clips or compression sleeves. But it is better to order wire rope slings from a rigging distributor and request an OSHA tag for each sling, which provides added product liability safety.

Self-regulatory industry design factors for wire rope suspension systems are 5:1 for static loads and 8:1 for moving wire-rope systems.

- **Chain:** OSHA 1910.184 applicable to chain lifting slings requires no less than an annual inspection and possible certification of proof load. This standard makes chain slings impractical for most loudspeaker suspension systems. But if a chain sling must be used, only two grades are allowed for overhead suspension — Grade 5 or Grade 8. With both of these grades, the chain is available only in larger sizes and must be certified and tagged by the rigging distributor.

- **Threaded rod:** Threaded rod can be an excellent tool if used properly, but applications are limited because threaded rod is not built for bending or torsion. As long as threaded rod is loaded only in tension, it can be very strong. Threaded rod comes in many grades; grade B7 is one of the most popular high tensile strength grades, and it is readily available at steel suppliers and fastener suppliers. Low-grade threaded rods are not appropriate for overhead suspension applications.

- **Fiber slings:** Fiber slings are generally not appropriate for permanent installations because of the fire hazard presented by the nylon, polyester and Kevlar fibers used in their construction. Although the melting point of some fiber slings is above that of wood, fiber slings are generally not accepted by fire hazard regulatory agencies. Fiber slings are excellent tools for installing suspension systems and for suspending loudspeaker clusters temporarily while more acceptable means of suspension are being made.

- **Hardware:** The most common hardware types are shackles, turnbuckles, locking steel carabiners, quick links and sling links. With all of these hardware types, it is mandatory to have the manufacturer certification for overhead suspension. This must be stressed with hardware because imported hardware comes from multiple sources, and you could re-

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