Reinforcement Systems for Shielded Rooms

A reinforcement system of braces and stiffeners is necessary for shielded rooms which exceed 12 feet in height or width. Several low-cost options are described.

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INTRODUCTION

When bidding on an enclosure that exceeds 12 feet in height and/or width, an extra bracing cost must be included. Usually, the extra bracing will be constructed with an I- or H-beam, an open web joist, or unistruts. Bracing angles to a wall or ceiling is rarely a possibility. This is particularly true when the enclosure is freestanding, and wall and/or ceiling attachment is not possible. This article describes several low-cost alternatives. The systems are simple and require the installation labor of only one person, with no special field equipment for material handling.

An additional benefit is that the systems described utilize those short scraps of intermediates that would ordinarily end up in a rubbish bin. How many times has a contractor seen these scraps being thrown out and wished for a way to use this expensive material?

The three parts of this article address:

- Enclosures of 12 feet in height and/or width, using back-to-back hat sections.
- Enclosures over 12 feet wide, using a reclaimed intermediate system.
- Cautionary disclaimers and signs for enclosures.

THE BACK-TO-BACK HAT SYSTEM CONSTRUCTION

The back-to-back hat system is assembled as shown in Figure 1. In a 12-foot height or width, a 10-foot extra hat intermediate is added to the outside of the enclosure, positioned one foot from each end. The only materials needed are the hat section, twenty-eight $^1/_4$"-20-1" screws, and twenty-eight $^1/_4$"-20 thread couplings for each additional hat section. Either tap-tight screws or standard screws can be used. The couplings are available in 100-count boxes from any good hardware supply house at a reasonable cost (Figure 2).

This system is assembled after the enclosure has been constructed in the normal manner. It may be necessary to temporarily wood-brace a wall that will need this reinforcement. If there is room for a person above the enclosure ceiling, the extra hats can be installed after construction is completed and temporary wood bracing is to be removed. If there is no room above the enclosure ceiling for an installer, then the ceiling braces are installed, panel by panel, using temporary wood braces.

This system will support additional weights such as microwave absorbers or lighting fixtures. It is not recommended for a dead load of more than 5 pounds per square foot over the normal room load.

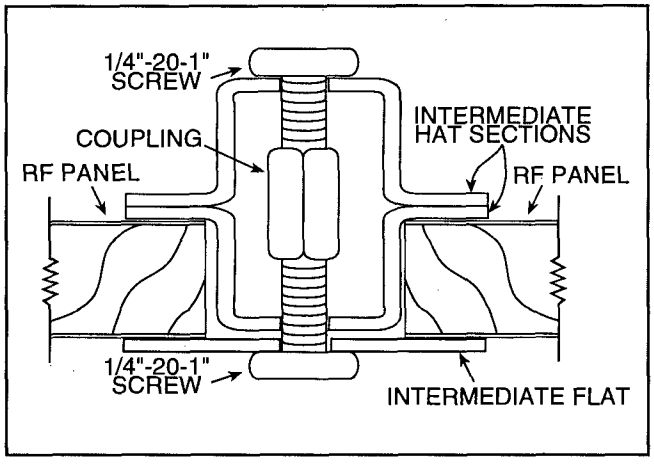


Figure 1. *Hat-to-Hat Section.*

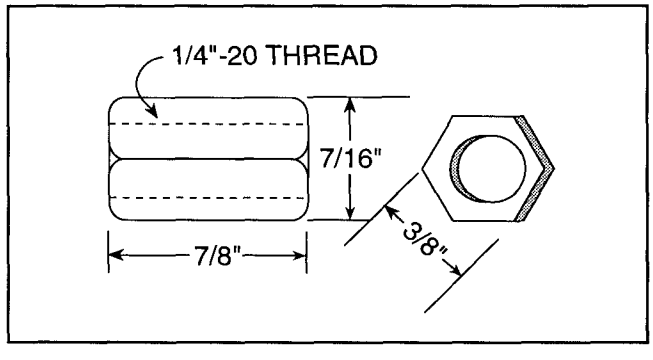


Figure 2. *Steel Couplings.*

OPEN WEB JOIST CONSTRUCTION

The second bracing system is a bit more complicated. Unlike the more common one-piece section, this system is based on an open web joist construction, but is field assembled.

The manufacture of these sections at the factory is a simple process. Figure 3 shows the tension member, made from a 28-inch flat. The bends indicated (33 or 147 degrees) will result in a piece that will meet the dimensions shown. This piece is placed in the open web joist system where there is a tension requirement.

Figure 4 illustrates a tension member attached to a 12-inch hat section to stabilize the member. Like all internal members in an open web construction, the piece acts as a compression member. Sections for a 16-foot and 20-foot span are shown in Figure 5. Note that the open web construction stops 2 feet short of the enclosure walls. For normal construction, this is sufficient length. However, if a dead load above normal (5 pounds per square foot) is anticipated, then the open web can be made 4 feet longer and extend from wall to wall. This will slightly raise the dead load capability to about 8 pounds per square foot dead load. It will also further stabilize the overall enclosure construction.

The assembly of the open web system is quite simple (Figure 6). Remember that the two end members are tension members. All others are compression members. The bolts at the top of the

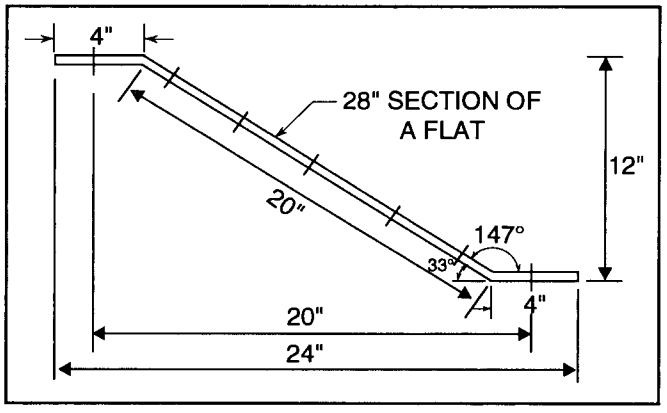


Figure 3. *Tension Member.*

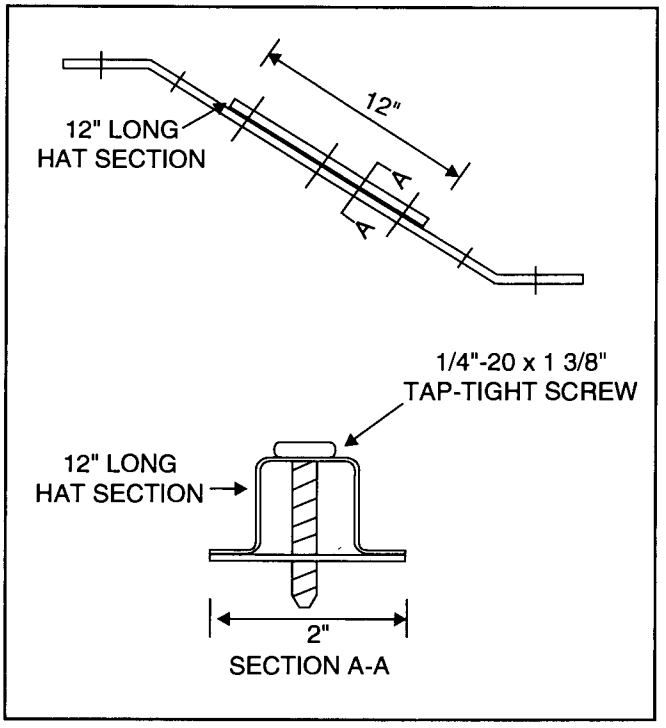


Figure 4. *Compression Member.*

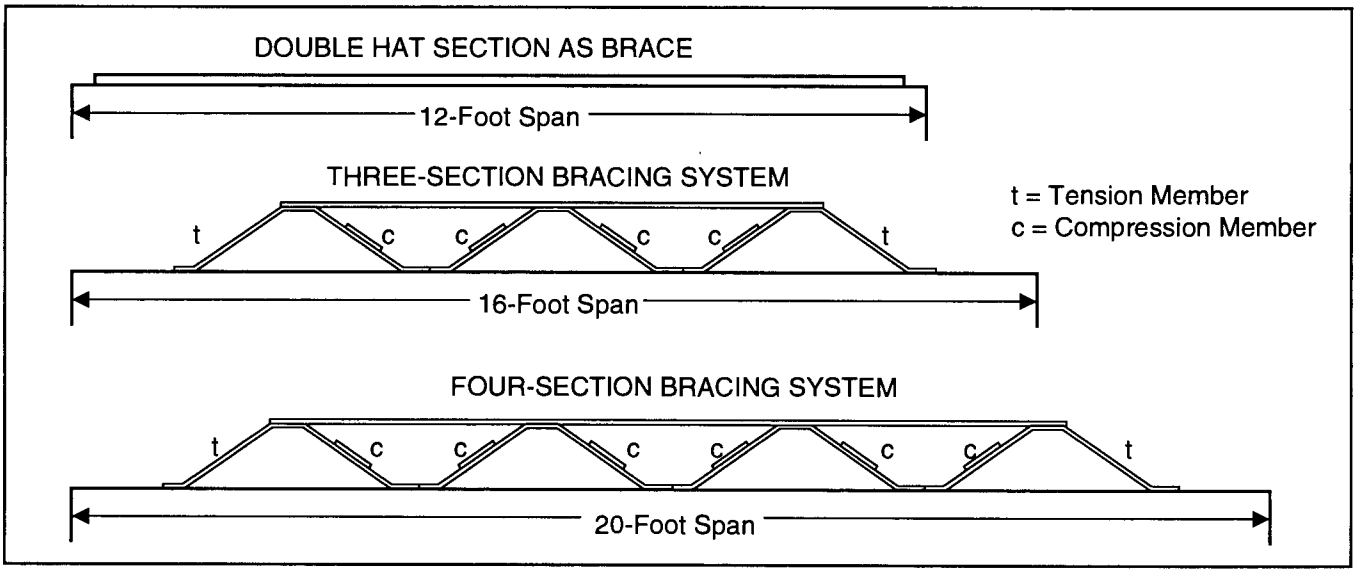


Figure 5. *Open Web Construction.*

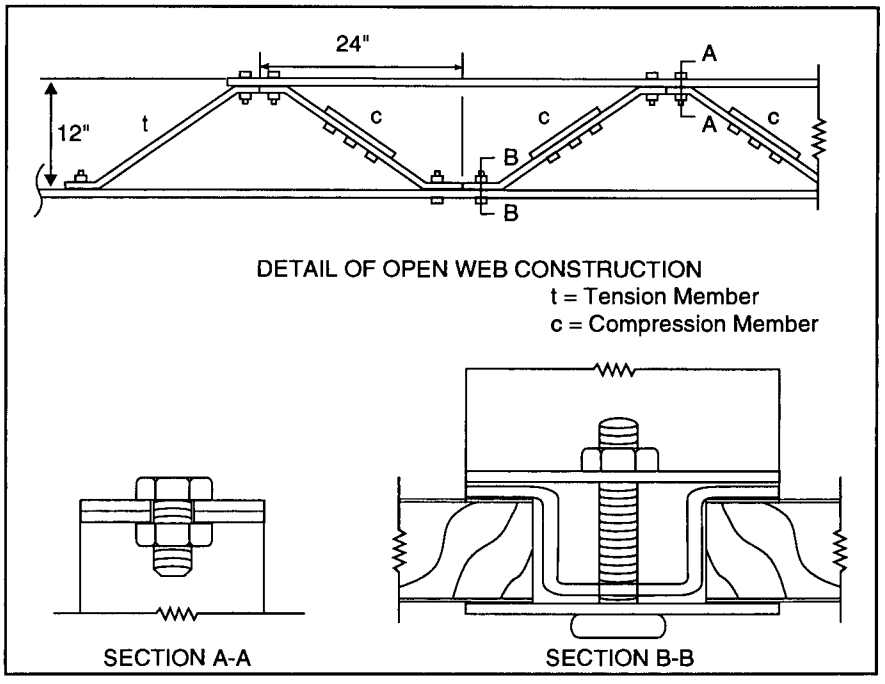


Figure 6. *Assembly of Open Web System.*

open web system are standard $^1/_4$"-20-$^3/_4$" with nuts. The bolts for the attachment to the enclosure are $^1/_4$"-20-$1^3/_8$" tap tights. The nut is a standard $^1/_4$"-20 thread.

The top bar is a flat that is 8 feet long on a three-span section, and 12 feet long on a four-span section. This flat may be installed in pieces, but for best strength and stability, one piece is recommended.

A flat is installed on each open web system at a diagonal to the adjacent open web system. This will laterally stabilize the overall system. The flat should be positioned at a 45-degree angle from the open webs. Typically, this flat will be 5'8" in length.

Where pieces of flat butt together, an even and full contact mating surface of the flat ends must be maintained. This ensures optimum strength and stability of the system.

The field installation of this system is quite simple. After the installation of a wooden T-bar system to temporarily support the ceiling, access to the joint is safe. Note that each separate section of the open web system is easily carried to the installation position by one person alone. After determining the exact location of the system attachment to the enclosure ceiling, the appropriate ceiling screws are removed and replaced with $1^3/_8$" screws. These screws will protrude above the enclosure intermediate about $^3/_8$", which is enough for the attachment of the open web system.

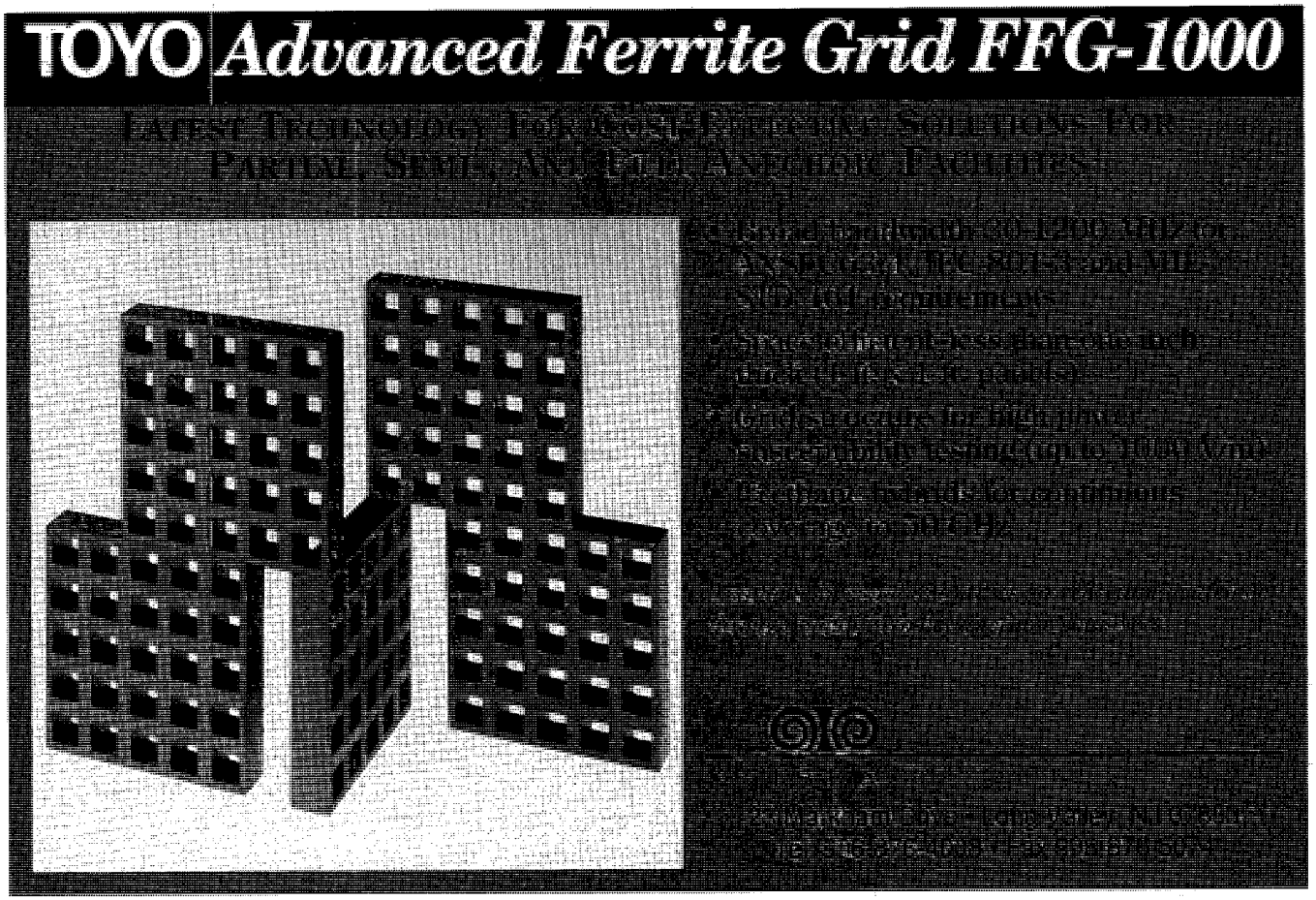
Now all of the tension and compression members are installed using $^1/_4$" standard nuts. The top flat can then be installed using standard $^1/_4$"-20-$^3/_4$" screws and nuts. Tap-tight screws need not be used here.

As each section is installed, the diagonal flat that will tie each open web system to the

next parallel system is installed using $^1/_4$"-20-$^3/_4$" standard screws and nuts. Again, tap-tight screws need not be used, unless it is more convenient to do so. As each open web system is completed, the wooden T-bar support system is removed.

DISCLAIMERS AND ENCLOSURE SIGNS

All too often, enclosures are installed without instructional signs and disclaimers attached to the completed enclosure. The contractor should have a pretty good idea of the live and dead loads that an installed enclosure system will tolerate. The customer may have no idea where these limits lie. Cases have been reported in which the customer removed ceiling screws to replace them with eyebolts. The ceiling sagged under the additional weight. Other cases have involved bowed walls where added shelving was overloaded. Calculated design parameters must be communicated to the customer, and the limitations of the design must be included in every guarantee. Clear language at the outset can eliminate problems that are the result of poor bidding, incomplete contracts, or failure to notify the customer of distinct limitations.



Customers should be made aware that to exceed set limits is to void the enclosure guarantee.

Figure 7 suggests wording for a sign which should be placed at the ceiling line of the enclosure wall on every exposed panel. This is a suggested sign only. These limits will change not only with manufacturers, but with construction methods and materials used.

RF ENCLOSURE LOAD LIMITS
DEAD LOAD —
5 POUNDS PER SQUARE FOOT-MAXIMUM
NO LIVE LOAD ALLOWED

Figure 7. *Suggested Sign to Stipulate Load Limits.*

RF ENCLOSURE LIMITS
DO NOT EXCEED 5 LBS. PER SQ. FT.
OR PUT ANY LIVE LOAD
ON THE CEILING—
IF LIMITS ARE EXCEEDED
ENCLOSURE GUARANTEE IS VOID.

Figure 8. *Suggested Sign for RF Enclosure Door.*

An additional sign should be placed at the enclosure entrance door to draw specific attention to the ceiling (and wall) load limits (Figure 8).

CONCLUSION

The bracing that is discussed here is shown entirely attached to the exterior of the enclosure. This is by no means a hard and fast rule. Job conditions may exist where there is just no room for the systems. It may well be that no system meets the requirements due to space limitations. In such an instance, a review of the details given here may offer options for applying the additional bracing to the internal enclosure surfaces. Small adjustments to the assembly sequences and to the particular hardware would be necessary. However, in those instances, the labor and materials used would be similar to an external bracing installation. In addition, the load capabilities would also be similar.

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