Design No. D925
December 10, 2003

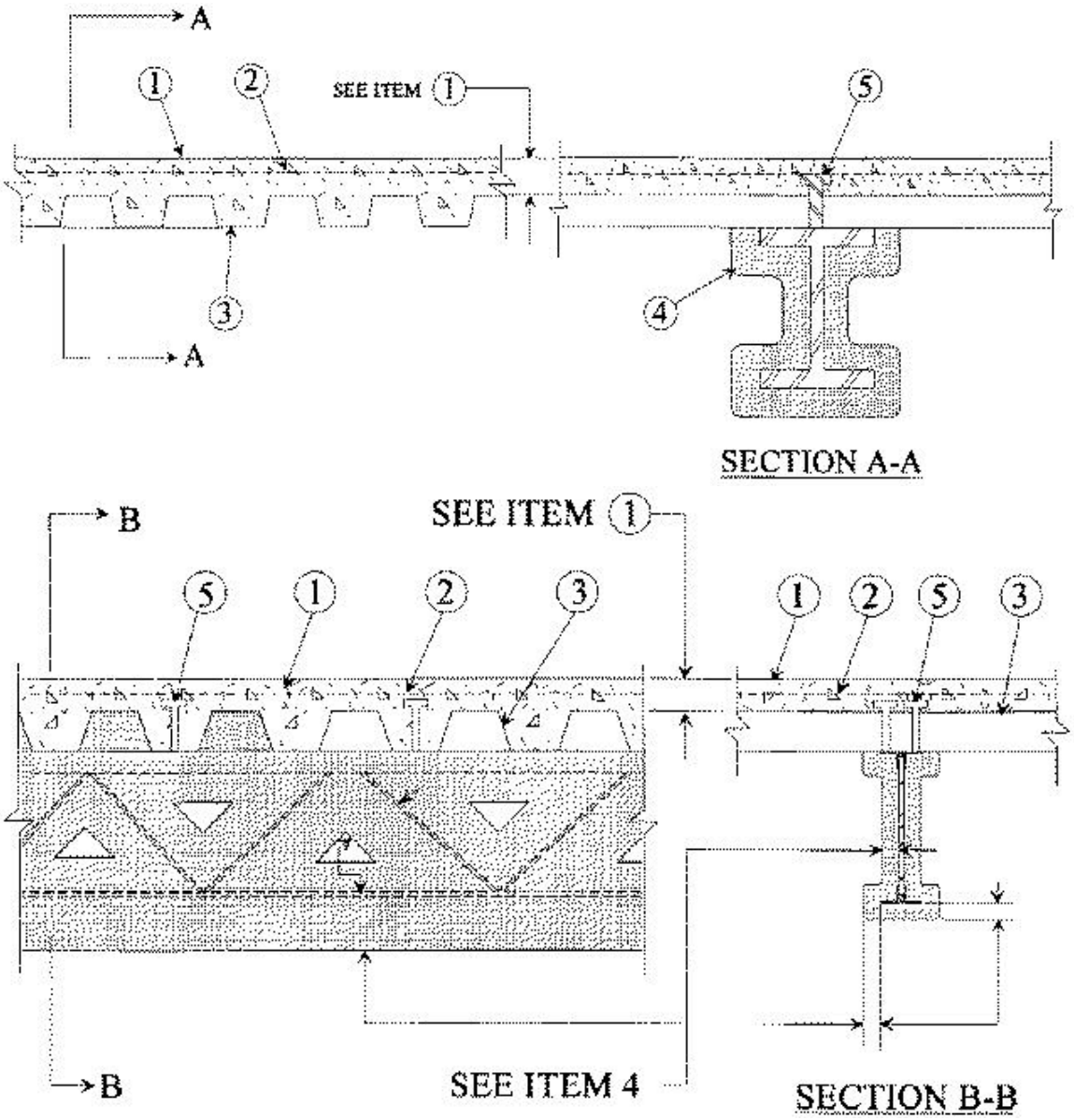
Restrained Assembly Ratings — 3/4, 1, 1-1/2, 2 or 3 Hr

(See Items 1, 6 and 10)

Unrestrained Assembly Rating — 0 Hr (See Items 3, 4, 4A and 10)

Unrestrained Beam Ratings — 1, 1-1/2, 2, 3 and 4 Hr

(See Items 4, 4A and 10)



Supports — W8x28 or W12x16 min size steel beam or steel Joists, 10K1 or 16K2 min size with a max tensile stress of 30,000 psi or 12K3 min size with a max tensile stress of 24,000 psi. Or joist girders (not shown), composite or noncomposite. Welded or bolted to end supports. Joist Girder designed per S.J.I. specifications for a max tensile stress of 30 ksi. May be either uncoated or provided with a shop coat of paint. **For the 2 h or less Restrained or Unrestrained Beam Ratings,** top and bottom chords shall each consist of two angles with a min total area of 0.96 and 0.77 sq in., respectively. Web members shall be

either round bars or angles. Min area of the end diagonal web shall be 0.444 sq in. Min area of each of the first six interior diagonal webs shall be 0.406 sq in. All other interior webs shall have a min area of 0.196 sq in. **For the 3 h Restrained or Unrestrained Beam Ratings,** each of the top and bottom chords shall each consist of two angles with a min total area of 1.74 sq in. Web members shall be either round bars or angles. Min area of each of the first five end diagonal webs shall be 0.886 sq in. All other interior webs shall have a min area of 0.441 sq in. **For the 4 h Restrained or Unrestrained Beam Ratings,** each of the top and bottom chords shall consist of two angles with a min total area of 1.74 sq in. Web members shall be either round bars or angles. Min area of each of the first five end diagonal webs shall be 0.886 sq in. All other interior webs shall have a min area of 0.441 sq in. Compression web members with a slenderness ratio greater than 60, shall be limited to 80 percent of their allowable design load. Bridging per S.J.I. specifications is required when noncomposite joists are used. For noncomposite joists, steel filler pieces of proper size, 1 to 2 in. long shall be welded to and between the top chord angles at midway between all top chord panel points.

As alternate to double angles, (not shown) structural tee sections may be used for top and bottom chords as follows:

Restrained or Unrestrained Beam Rating Hr	Min Size Section	
	Top Chord	Bottom Chord
1, 1-1/2 or 2	ST1.5X3.75	ST1.5X2.85
3 or 4	ST3X6.25	ST3X6.25

1. **Normal Weight or Lightweight Concrete —** Normal weight concrete carbonate or siliceous aggregate, 3500 psi compressive strength, vibrated. Lightweight concrete, expanded shale, or slate aggregate by rotary-kiln method, or expanded clay aggregate by rotary-kiln or sintered-grate method, 3000 psi compressive strength, vibrated, 4 to 7 percent entrained air.

Restrained Assembly Rating Hr	Concrete (Type)	Concrete Unit Weight pcf	Concrete Thkns In.
1	Normal Weight	147-153	3-1/2
1-1/2	Normal Weight	147-153	4
2	Normal Weight	147-153	4-1/2
3	Normal Weight	147-153	5-1/4
3/4 or 1	Lightweight	107-113	2-1/2
(See Item 6)			
1	Lightweight	107-120	2-5/8
1-1/2	Lightweight	107-113	3
2	Lightweight	107-113	3-1/4
2	Lightweight	107-116	3-1/4*
2	Lightweight	114-120	3-1/2
3	Lightweight	107-113	4-3/16
3	Lightweight	114-120	4-7/16

*For use with 2 or 3 in. steel floor and form units only.

2. **Welded Wire Fabric —** 6 x 6, 10 x 10 SWG.

3. **Steel Floor and Form Units* —** Composite 1-1/2, 2 or 3 in. deep galv units. Fluted units may be uncoated or phosphatized/painted. Min gauges are 22 MSG for fluted and 20/20 MSG for cellular units. The following combinations of units may be used:

(1) All 24 or 36 in. wide cellular.

(2) All fluted.

(3) One or two 3 in. deep, 12 in. wide, 18/18 MSG min cellular units, alternating with 3 in. deep fluted or other cellular.

(4) Any blend of fluted and 24 or 36 in. wide cellular.

(5) 3 in. deep, 30 in. wide cellular with 8-1/8 in. wide valley alongside joints may be used when 3/8 in. diam reinforcing bars are placed 1-1/2 in. to each side of side joints and 1 in. above bottom of units.

CONSOLIDATED SYSTEMS INC — 24 or 36 in. wide Types CFD-2, CFD-3; 24, 30 or 36 in. wide Type CFD-1.5; 24 in. wide; Type NC; 24 in. wide Type Versa-Dek® S, LS, XLS. Units may be phos/ptd.

Spacing of welds attaching units to supports shall be 12 in. OC for 24 and 36 in. wide units, four welds per sheet for 30 in. wide units. Unless noted otherwise, adjacent units button-punched or welded together 36 in. OC alongside joints. For 3 Hr Rating, units with overlapping type side joints welded together 24 in. OC max.

The Unrestrained Assembly Rating is equal to the Unrestrained Beam Rating for a max of 3 Hr and is limited to the following floor units and spans:

(a) 1-1/2, 2 and 3 in. deep, 24 in. wide, 22 MSG or thicker fluted with clear spans not more than 7 ft, 8 in.

(b) 1-1/2, 2 and 3 in. deep, 24 in. wide, 20 MSG or thicker fluted with clear spans not more than 8 ft, 8 in.

(c) 1-1/2 and 2 in. deep, 24 in. wide, 16 MSG or thicker fluted and 18/18 MSG or thicker cellular with clear spans not more than 9 ft, 11 in.

(d) 3 in. deep, 36 in. wide, 18 MSG or thicker fluted and 24 in. wide, 20/18 MSG or thicker cellular with clear spans not more than 13 ft, 2 in.

For assemblies utilizing 3-1/4 in. lightweight concrete topping with a max Restrained Assembly Rating of 2 Hr, the Unrestrained Assembly Rating is equal to the Unrestrained Beam Rating and is limited to the following floor units and spans:

(a) 1-1/2, 2, and 3 in. deep, 24 or 36 in. wide, 22 MSG fluted and 20/20 MSG cellular with clear spans not more than 9 ft, 6 in.

(b) 2 and 3 in. deep, 24 or 36 in. wide 20 MSG fluted and 20/20 MSG cellular with clear spans not more than 10 ft, 0 in.

(c) 3 in. deep, 24 in. wide, 20 MSG fluted and 20/20 MSG cellular with clear spans not more than 13 ft, 2 in.

4. **Spray-Applied Fire Resistive Materials —** Applied by mixing with water and spraying in one or more coats to a final thickness as shown in the tables below, to steel beam surfaces which must be clean and free of dirt, loose scale and oil. Min avg and min ind density of 15/14 pcf, respectively for Types MK-6/CBF, MK-6/ED, MK-6/HY, MK-6/HY Extended Set, MK-6s, RG. Min avg and min ind density of 22/19, respectively for Types Z-106. For method of density determination, refer to Design Information Section.

Restrained Assembly Rating Hr	Unrestrained Assembly Rating Hr	Unrestrained Beam Rating Hr	Spray Applied Fire Resistive Mtl Thk In.			
			W8x28 Beam	W8x28 Beam Supporting All Fluted Floor Units w/Lightweight Concrete	W12x16 Beam	W12x16 Beam Supporting All Fluted Floor Unit
1	1	1	1/2,	7/16,	11/16,	5/8,
			11/16**	5/8**	1-1/8**	1**
1-1/2	1	1	1/2,	7/16,	11/16,	5/8,
			11/16**	5/8**	1-1/8**	1**
1-1/2	1-1/2	1-1/2	13/16,	3/4,	1-1/8,	1,
			1-1/16**	1**	1-7/16**	1-3/8**
2	1	1	1/2,	7/16,	11/16,	5/8,
			11/16**	5/8**	1-1/8**	1**
2	2	2	1-1/16,	1,	1-7/16,	1-3/8,
			1-5/16**	1-3/16**	1-13/16**	1-9/16**
3	1-1/2	1-1/2	13/16	3/4	1-1/8	1
3	3	3	1-9/16	1-5/16	2-1/8	1-3/4
3	3	4	2	1-5/8	2-11/16	2-3/16

**This thickness applies when optional Item 10 is used over 3-1/4 in. light weight concrete topping.

The thicknesses of Spray-Applied Fire Resistive Materials shown in the table below are applicable when the thickness applied to the beams' lower flange edges is reduced to one-half that shown in the table.

Restrained Assembly Rating Hr	Unrestrained Assembly Rating Hr	Unrestrained Beam Rating Hr	Spray Applied Fire Resistive Mtl Thk In.			
			W8x28 Beam	W8x28 Beam Supporting All Fluted Floor Units w/Lightweight Concrete	W12x16 Beam	W12x16 Beam Supporting All Fluted Floor Unit
1	1	1	9/16	7/16+	3/4	5/8
1-1/2	1	1	9/16	7/16+	3/4	5/8
1-1/2	1-1/2	1-1/2	7/8	3/4	1-3/16	1
2	1	1	9/16	7/16+	3/4	5/8
2	2	2	1-3/16	1	1-5/8	1-3/8
3	1-1/2	1-1/2	7/8	3/4	1-3/16	1

3	3	3	1-3/4	1-9/16	2-3/8	2-1/8

Restrained Assembly Rating Hr	Unrestrained Assembly Rating Hr	Unrestrained Beam Rating Hr	Spray-Applied Resistive Materials Thk, In. W8x28 supporting Fluted Floor Units and Normal Weight Concrete Only
1	1	1	3/8
1-1/2	1-1/2	1-1/2	5/8
2	1	1	3/8
2	2	2	7/8
3	1-1/2	1-1/2	5/8
3	3	3	1-7/16
3	3	4	2

3	3	4	2-5/16	2-1/16	3-1/8	2-3/4

+Thickness applied to beams' lower flange edges shall be a minimum of 1/4 in.

			Spray Applied Fire Resistive Mtl Thkns In.		
Restrained Assembly Rating Hr	Unrestrained Assembly Rating Hr	Unrestrained Beam Rating Hr	For 10K1 Joist Spaced		
			More Than 4 Ft OC	4 Ft or Less OC	Joist Girder
1	1	1	1-1/8	15/16	1-1/8
1-1/2	1-1/2	1-1/2	1-5/8	1-7/16	1-3/4
2	1	1	1-7/16	1-7/16	—
2	2	2	2-3/16	1-7/8	2-1/4
3	3	3	3-1/2	2-13/16	2-7/8
3	3	4	—	—	2-7/8

Restrained & Unrestrained Assembly Rating Hr	Unrestrained Beam Rating Hr	Spray Applied Fire Resistive Mtl Min Thkns In. For *12K3 or 16K2 Joist Spaced	
		More Than 4 Ft OC	4 Ft or Less OC
1	1	15/16	15/16
1-1/2	1-1/2	1-1/2	1-3/8
2	2	2-1/16	1-7/8
3	3	3-1/2	2-13/16

*Note: Design load shall stress the 12K3 joist to a maximum tensile strength of 24,000 psi. For guidance on stress level adjustments, refer to the Fire Resistance Ratings with Steel Joists section of the Steel Joist Institute (SJI) publication: "Catalog of Standard Specifications and Load Tables for Steel Joists and Joist Girders."

ARABIAN VERMICULITE INDUSTRIES — Types MK-4, MK-6/CBF , -6/ED, -6/HY, -6/HY Extended Set, -6s, Sonophone 1, Z-106, Z-106/G.

W R GRACE & CO - CONN CONSTRUCTION PRODUCTS DIV — Types KM-601, MK-6/HY, MK-6/HY Extended Set, MK-6s, RG, Monokote Acoustic 1, Z-106/G, Z-106, Monokote Acoustic 5.

GRACE KOREA INC — Types MK-6/CBF, MK-6/ED, MK-6/HY, MK-6/HY Extended Set, MK-6s, Monokote Acoustic 1, Z-106/G, Z-106, Monokote Acoustic 5.

4A. **Alternate Spray-Applied Fire Resistive Materials —** Applied by mixing with water and spraying in one or more coats to a final thickness as shown in the tables below to steel beam surfaces which must be clean and free of dirt, loose scale and oil. The thicknesses shown in the table below are applicable to beams supporting all fluted floor or form units. Min avg and min ind density of 22/19 pcf respectively. For density determination refer to Design Information Section.

Restrained Assembly Rating Hr	Unrestrained Assembly Rating Hr	Unrestrained Beam Rating Hr	Spray Applied Fire Resistive Mtl Thk In. W8x28 Beam Supporting Fluted Floor Units Only W/ Lightweight Concrete
1	1	1	1/2, 5/8**
1-1/2	1-1/2	1-1/2	3/4, 1**
2	1	1	1/2, 5/8**
2	2	2	1, 1-3/16**
3	1-1/2	1-1/2	3/4
3	3	3	1-5/16
3	3	4	1-5/8

			Spray Applied Fire Resistive Mtl Thkns In.		
Restrained Assembly Rating Hr	Unrestrained Assembly Rating Hr	Unrestrained Beam Rating Hr	For 10K1 Joist Spaced		
			More Than 4 Ft OC	4 Ft or Less OC	Joist Girder
1	1	1	1-1/8	15/16	1-1/8
1-1/2	1-1/2	1-1/2	1-5/8	1-7/16	1-3/4
2	1	1	1-7/16	1-7/16	—
2	2	2	2-3/16	1-7/8	2-1/4
3	3	3	3-1/2	2-13/16	2-7/8
3	3	4	—	—	2-7/8

Restrained & Unrestrained	Unrestrained	Spray Applied Fire Resistive Mtl Min Thkns In. For *12K3 or 16K2 Joist Spaced

Assembly Rating Hr	Beam Rating Hr	More Than 4 Ft OC	4 Ft or Less OC
1	1	15/16	15/16
1-1/2	1-1/2	1-1/2	1-3/8
2	2	2-1/16	1-7/8
3	3	3-1/2	2-13/16

Restrained Assembly Rating Hr	Unrestrained Assembly Rating Hr	Unrestrained Beam Rating Hr	Spray-Applied Resistive Materials Thk, In. W8x28 supporting Fluted Floor Units and Normal Weight Concrete Only
1	1	1	3/8
1-1/2	1-1/2	1-1/2	5/8
2	1	1	3/8
2	2	2	7/8
3	1-1/2	1-1/2	5/8
3	3	3	1-7/16
3	3	4	2

*Note: Design load shall stress the 12K3 joist to a maximum tensile strength of 24,000 psi. For guidance on stress level adjustments, refer to the Fire Resistance Ratings with Steel Joists section of the Steel Joist Institute (SJI) publication: "Catalog of Standard Specifications and Load Tables for Steel Joists and Joist Girders."

**This thickness applies when optional Item 10 is used over 3-1/4 in. light weight concrete topping.

ARABIAN VERMICULITE INDUSTRIES — Types Z-106/HY

W R GRACE & CO - CONN CONSTRUCTION PRODUCTS DIV — Type Z-106/HY.

GRACE KOREA INC — Type Z-106/HY.

4B. **Alternate Spray-Applied Fire Resistive Materials —** Applied by mixing with water and spraying in one or more coats to a final thickness as shown in the tables below to steel beam surfaces which must be clean and free of dirt, loose scale and oil. The thicknesses shown in the table below are applicable to beams supporting all fluted floor or form units. Min avg and min ind density of 40/36 pcf respectively. For density determination refer to Design Information Section.

Restrained Assembly Rating Hr	Unrestrained Assembly Rating Hr	Unrestrained Beam Rating Hr	Spray Applied Fire Resistive Mtl Thk In. W8x28 Beam Supporting Fluted Floor Unit Only W/ Lightweight Concrete
1	1	1	7/16, 5/8**
1-1/2	1-1/2	1-1/2	3/4, 1**
2	1	1	7/16, 5/8**
2	2	2	1, 1-3/16**
3	1-1/2	1-1/2	3/4
3	3	3	1-5/16
3	3	4	1-5/8

			Spray Applied Fire Resistive Mtl Thkns In.		
Restrained Assembly Rating Hr	Unrestrained Assembly Rating Hr	Unrestrained Beam Rating Hr	For 10K1 Joist Spaced		
			More Than 4 Ft OC	4 Ft or Less OC	Joist Girder
1	1	1	1-1/8	15/16	1-1/8
1-1/2	1-1/2	1-1/2	1-5/8	1-7/16	1-3/4
2	1	1	1-7/16	1-7/16	—
2	2	2	2-3/16	1-7/8	2-1/4
3	3	3	3-1/2	2-13/16	2-7/8
3	3	4	—	—	2-7/8

Restrained & Unrestrained Assembly Rating Hr	Unrestrained Beam Rating Hr	Spray Applied Fire Resistive Mtl Min Thkns In. For *12K3 or 16K2 Joist Spaced	
		More Than 4 Ft OC	4 Ft or Less OC
1	1	15/16	15/16
1-1/2	1-1/2	1-1/2	1-3/8
2	2	2-1/16	1-7/8
3	3	3-1/2	2-13/16

Restrained Assembly Rating Hr	Unrestrained Assembly Rating Hr	Unrestrained Beam Rating Hr	Spray-Applied Resistive Materials Thk, In. W8x28 supporting Fluted Floor Units and Normal Weight Concrete Only
1	1	1	3/8
1-1/2	1-1/2	1-1/2	5/8

2	1	1	3/8
2	2	2	7/8
3	1-1/2	1-1/2	5/8
3	3	3	1-7/16
3	3	4	2

*Note: Design load shall stress the 12K3 joist to a maximum tensile strength of 24,000 psi. For guidance on stress level adjustments, refer to the Fire Resistance Ratings with Steel Joists section of the Steel Joist Institute (SJI) publication: "Catalog of Standard Specifications and Load Tables for Steel Joists and Joist Girders."

**This thickness applies when optional Item 10 is used over 3-1/4 in. light weight concrete topping.

ARABIAN VERMICULITE INDUSTRIES — Type Z-146 investigated for exterior use, Sonophone 35.

W R GRACE & CO - CONN CONSTRUCTION PRODUCTS DIV — Types Z-146 investigated for exterior use , Monokote Acoustic 35.

GRACE KOREA INC — Types Z-146 investigated for exterior use , Monokote Acoustic 35.

5. **Shear-Connector-Studs-Optional —** Studs 3/4 in. diam by 3 in. long, for 1-1/2 in. deep form units to 5-1/4 in. long for 3 in. deep form units, headed type or equivalent per AISC specifications. Welded to the top flange of the beam through the steel form units.

6. **Electrical Inserts —** (Not shown) Classified as "Outlet Boxes and Fittings Classified for Fire Resistance".

H H ROBERTSON — Preset Inserts.

For use with 2-1/2 in. lightweight concrete topping over QL-WKX steel floor units. Installed over factory-punched holes in floor units per accompanying installation instructions. Spacing shall not be more than one insert in each 14 sq ft of floor area with spacing along floor units not less than 48 in. OC. The holes cut in insert cover for passage of wires shall be no more than 1/8 in. larger diam than wire. Restrained Assembly Rating is 3/4 hr with Tapmate II-FS-1 and 1 hr with Tapmate II-FS-2 inserts.

H H ROBERTSON — Tapmate II-FS-1, II-FS-2; Series KEB.

WALKER SYSTEMS INC — After set Inserts. Single-service after set inserts installed per accompanying installation instructions in 2-1/2 in. diam hole core-drilled through min 3-1/4 in. thick concrete topping to top of cell of any min 3 in. deep cellular steel floor unit specified under Item 3. Spacing shall be no more than one insert in each 10 sq ft of floor area in each span with a min center to center spacing of 16 in. If the high potential and low potential raceways of the cellular steel floor unit are separated by a valley filled with concrete, the center to center spacing of the high potential and low potential single-service after set inserts may be reduced to a min of 7-1/2 in. Restrained Assembly Rating is 2 hr or less with internally protected Type 436 after set insert with Type M4-, M6- or M8- Series single-service activation fitting.

WALKER SYSTEMS INC — Internally protected Type 436 after set insert with Type M4-, M6- or M8- Series single-service activation fitting.

7. **Roof Covering Materials* —** (Optional, not shown) Consisting of materials compatible with insulations described herein which provide Class A, B or C coverings. See Roofing Materials and Systems Directory - Roof Covering Materials (TEVT).

8. **Insulating Concrete —** (not shown) Optional. Various types of insulating concrete prepared and applied in the thickness indicated:

A. **Vermiculite Concrete —** (not shown) Optional.

1. Blend 6 to 8 cu ft of Vermiculite Aggregate* to 94 lb Portland Cement and air entraining agent. Min thickness of 2 in. as measured to the top surface of the structural concrete or foamed plastic (Item 9) when it is used.

ELASTIZELL CORP OF AMERICA — Types MS 16-U, MSV 200.

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2. Blend 3.5 cu ft. of Type NVC Concrete Aggregate* or Type NVS Vermiculite Aggregate* to 94 lb Portland Cement. Slurry coat, 1/8 in. thickness beneath foamed plastic (Item 9) when used, 1 in. min topping thickness.

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Vermiculite concrete may be covered with Roof Covering Materials (Item 7).

B. **Cellular Concrete-Roof Topping Mixture* —** Concentrate mixed with water and Portland Cement per manufacturers specifications. 28-day min compressive strength of 190 psi as determined with ASTM C495-66.

CELCORE INC — Cast dry density 31 (+ or -) 3.0 psf

CELLULAR CONCRETE L L C — Cast dry density of 37 (+ or -) 3.0 pcf.

ELASTIZELL CORP OF AMERICA — Type II. Mix #1 of cast dry density 39 (+ or -) 3.0 pcf, Mix #2 of cast dry density 40 (+ or -) 3.0 pcf, Mix #3 of cast dry density 47 (+ or -) 3.0 pcf.

LITE-CRETE INC — Cast dry density of 29 (+ or -) 3.0 pcf.

SIPLAST INC — Mix No. 1 or 2. Cast dry density of 32+3 (Mix No. 1) or 36+3 (mix No. 2) pcf.

C. **Perlite Concrete —** Mix consists of 6.2 cu ft Perlite Aggregate* to 94 lbs of Portland cement and 1-1/2 pt air entraining agent. Compressive strength 80 psi min.

See Perlite Aggregate (CFFX) category for names of Classified companies.

D. **Cellular Concrete-Roof Topping Mixture* —** Foam Concentrate mixed with water, Portland Cement and UL Classified Vermiculite Aggregate per manufacturer's application instructions. Cast dry density of 33 (+ or -) 3.0 pcf and 28-day compressive strength of min 250 psi as determined in accordance with ASTM C495-86.

CELLULAR CONCRETE L L C — Mix No. 3.

SIPLAST INC — Mix No. 3.

E. **Floor Topping Mixture* (Optional, not shown) —** Approx 4.5 gal of water to 41 lbs of NVS Premix floor topping mixture. Slurry coat 1/8 in. thickness beneath foamed plastic (Item 9) when used, 1 in. min topping thickness.

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Floor Topping Mixture may be covered with Built-Up or Single Membrance Roof Covering.

9. **Foamed Plastic* —** (Optional-not shown) For use only with vermiculate or cellular concretes or Floor Topping mixture (Item 8E) -Rigid polystyrene foamed plastic insulation having slots and/or holes sandwiched between vermiculite concrete slurry which is applied to the normal or lightweight concrete surface and concrete topping. Max thickness to be 8 in.

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10. **Roof Insulation-Mineral and Fiber Boards* or Foamed Plastic* —** (Optional, not shown) — Mineral and fiber boards or polyisocyanurate roof insulation applied over concrete floor with no restriction on board thickness. When mineral and fiber boards or polyisocyanurate roof insulation are used the unrestrained beam rating shall be increased by a min of 1/2 hr. See Mineral and Fiber Boards (CERZ) or Foamed Plastic (CCVW) category for names of Manufacturers.

*Bearing the UL Classification Mark

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