



# ICBO Evaluation Service, Inc.

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## EVALUATION REPORT

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Report No. 4427

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Filing Category: DESIGN—Masonry (038)

### HI-R MASONRY WALL SYSTEM

KORFIL, INCORPORATED

POST OFFICE BOX 1000

FREIGHTHOUSE ROAD

WEST BROOKFIELD, MASSACHUSETTS 01585

#### BASALITE

605 INDUSTRIAL WAY  
DIXON, CALIFORNIA 95620

#### COLORADO CONCRETE MANUFACTURING COMPANY

POST OFFICE BOX 15587

3155 DRENNAN ROAD

COLORADO SPRINGS, COLORADO 80935

#### FOAM PACKAGING INC.

POST OFFICE BOX 540373

NORTH SALT LAKE CITY, UTAH 84054

#### LAYRITE PRODUCTS CO.

POST OFFICE BOX 2585

SPOKANE, WASHINGTON 99220

#### MUTUAL MATERIALS CO.

POST OFFICE BOX 2009

BELLEVUE, WASHINGTON 98009

#### R.C.P. COMPANY INC.

8246 BROADWAY

POST OFFICE BOX 579

LEMON GROVE, CALIFORNIA 91945

#### TRI-SMITH INVESTMENT CORP./

dba BLOCK-LITE

3900 EAST INDUSTRIAL DRIVE

FLAGSTAFF, ARIZONA 86004

#### WESTERN MATERIALS, INC.

POST OFFICE BOX 430

YAKIMA, WASHINGTON 98907

I. Subject: HI-R Masonry Wall System.

II. Description: A. General: The HI-R Masonry Wall System consists of Korfil molded polystyrene inserts designed for use with hollow concrete masonry units that comply as Grade N units under U.B.C. Standard No. 24-4 with the exception of the minimum web thickness and the top of each web being notched to accommodate horizontal reinforcement. The masonry units are manufactured by concrete block manufacturers noted in this report with dimensions as shown in Figures Nos. 1, 2 and 3. Two curtains of Korfil inserts are installed in each masonry unit at the block manufacturing plant. The inserts are offset from one another to interlock with inserts in adjacent masonry units when assembled in a wall. The Korfil inserts are expanded from BASF Corporation Type BF-422 (ER-3401) or Arco Chemical Company Type Dylite M-77 (ER-3530) polystyrene beads to a density of 1.0 pcf. The inserts have a Class I flame-spread rating and a smoke-developed rating less than 450. See Figure No. 4 for additional detail of Korfil inserts.

B. Installation: The masonry units are installed in running bond pattern with Type S mortar installed at all head and face shell bed joints. For partial-grouted construction, the masonry unit cross webs adjacent to the

grouted cell are mortared to confine the grout. A stack bond pattern may be used for fully grouted walls. All cells of unreinforced masonry must be grouted. Grout must have a 28-day compressive strength of 4000 psi. All grout is consolidated by vibrating. Wall construction must comply with Section 2404 of the code. Anchor bolts and wall anchors must be embedded in fully grouted bond beams without the foam plastic inserts.

C. Design: Structures are designed in accordance with Sections 2405 through 2409, inclusive, of the Uniform Building Code with the following provisions:

1. Specified compressive strength,  $f_m$ , used in design must be between 1,500 psi and 2,000 psi.
2. Specified compressive strength,  $f_m$ , must be verified by prism tests as specified in Section 2406(b) 1 of the code.
3. Lintel beam design width must be the block width minus the foam insert thickness. Unreinforced masonry lintels must be grouted.
4. Allowable flexural compressive stress of reinforced and unreinforced beams and lintels are:

$$F_b = 0.16 f_m$$

5. Allowable shear stress in unreinforced beams and lintels is:

$$F_v = 0.20 (f_m)^{1/2}$$

6. Maximum wall height to thickness ratio,  $h/t$ , for reinforced walls is 30 with a maximum height of 20 feet for 8-inch-wide units, 25 feet for 10-inch-wide units and 30 feet for 12-inch-wide units.

7. Maximum wall height for unreinforced walls is 10 feet.

8. Sectional properties of wall are as specified in Table No. 1.

9. The nominal block width may be used as the value of "t" in the allowable wall axial compressive stress,  $F_a$  equations.

10. Allowable axial stress in unreinforced walls is:

$$F_a = 0.15 f_m [1 - (h/42t)^3]$$

11. Allowable axial stress in reinforced walls is:

$$F_a = 0.17 f_m [1 - (h/42t)^3]; (8\text{-inch-wide units})$$

$$F_a = 0.11 f_m [1 - (h/42t)^3]; (10\text{- and }12\text{-inch-wide units})$$

12. Provided the flexural compression zone does not exceed the face shell thickness or  $1\frac{3}{8}$  inches, whichever is less, the allowable flexural compressive stress of reinforced and unreinforced walls is:

$$F_b = 0.20 f_m'; (8\text{-inch-wide units}) \text{ and}$$

$$F_b = 0.18 f_m'; (10\text{- and }12\text{-inch-wide units})$$

13. The following allowable flexural tensile stress in unreinforced walls must be reduced in accordance with Section 2406(c) 4 of the code:

$$F_t = 23 \text{ psi.}$$

14. Allowable flexural shear stress of unreinforced walls is 1 psi.

15. Allowable flexural shear stress of reinforced walls is:

$$F_v = .28 (f_m)^{1/2}; (8\text{-inch-wide units})$$

$$F_v = .26 (f_m)^{1/2}; (10\text{- and }12\text{-inch-wide units})$$

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16. Steel reinforcement shall be located in the center of the grouted section. Reinforcement for vertical cells located at ends of shear walls are limited to maximum No. 8 bars when inserts are used.

17. Allowable in-plane shear stress of reinforced walls must be based on the reinforcing steel resisting all shear.

18. Allowable shear values specified in Table No. 24-J of the code for anchor bolts embedded in fully grouted bond beams without the foam plastic inserts are permitted.

D. **1990 Accumulative Supplement to the U.B.C.:** This report is unaffected by the Supplement.

E. **Identification:** Each shipping container of Korfil HI-R inserts received by block manufacturer has a label bearing product name, date of manufacture, container number, evaluation report number, Class I flamespread rating, smoke-developed rating and the name of the quality control agency RADCO (NER-QA204). The concrete masonry units containing the Korfil HI-R inserts are palletized and are identified with delivery slips which bear the masonry unit manufacturer's name and the evaluation report number.

III. **Evidence Submitted:** Reports of transverse, diagonal tension, compression, flexural load tests and quality control manual.

### Findings

IV. **Findings:** That the HI-R Masonry Wall System described in this report complies with the 1988 Uniform Building Code, subject to the following conditions:

1. Verification must be submitted to the building official that the masonry units comply as Grade N units in accordance with

U.B.C. Standard No. 24-4, excepting minimum web thickness and web height.

2. Plans and calculations for each project are submitted to the building official for approval.
3. Design and construction complies with this report, and the manufacturer's instructions.
4. Walls are limited to two-story structures supporting no more than a roof and one floor with a maximum unsupported wall height of 10 feet for unreinforced walls and maximum wall height for reinforced walls as limited in Section II C-6 of this report.
5. Special inspection is provided in accordance with Section 306 (a) 7 of the code for installations in Seismic Zones 3 and 4. Special inspection is necessary for installations in Seismic Zones 0, 1 and 2 unless design stresses are reduced in accordance with Section 2406(c)1 of the code.
6. Foam plastic inserts are manufactured under a quality control program with follow-up inspections by RADCO (NER-QA204) at the following locations.
  - A. Energy Performance Systems, Freighthouse Road, West Brookfield, Massachusetts 01585.
  - B. Foam Packaging Inc., 637 West 3560 South, Salt Lake City, Utah 84119.
7. The Korfil HI-R inserts are installed in the masonry units at the facilities of the masonry unit manufacturers noted in this report.

This report is subject to re-examination in one year.

TABLE NO. 1—SECTIONAL PROPERTIES OF KORFIL HI-R MASONRY UNITS WITH INSULATION INSERTS. PROPERTIES PER FOOT OF WALL.

NOMINAL BLOCK WIDTH (Inches)	GROUTED CELL SPACING (Inches)	NET CROSS SECTIONAL AREA, $A_g^1$ (Inches <sup>2</sup> )	NET CROSS SECTIONAL AREA, $A_n$ PERCENT SOLID	NET MOMENT OF INERTIA $I$ (Inches <sup>4</sup> )	SECTION MODULUS $S$ , (Inches <sup>3</sup> )	
					Insulation Side	Grouted Side
8	8	60.0	65.6	364	82.8	113.0
	16	48.6	53.1	352	83.2	104.0
	24	43.4	47.4	345	83.7	98.8
	32	40.8	44.6	342	84.1	95.9
	40	39.2	42.9	339	84.3	94.1
	48	38.2	41.8	337	84.5	92.9
	UngROUTED	33.0	36.1	327	85.9	85.9
10	8	84.0	72.7	700	126.0	172.0
	16	63.8	55.2	665	124.0	157.0
	24	54.5	47.2	647	123.0	148.0
	32	49.9	43.2	637	123.0	143.0
	40	47.1	40.8	630	123.0	140.0
	48	45.3	39.2	626	123.0	138.0
	UngROUTED	36.0	31.2	601	125.0	125.0
12	8	108.0	77.4	1245	188.0	249.0
	16	80.2	57.5	1165	181.0	225.0
	24	67.4	48.3	1126	179.0	212.0
	32	61.1	43.8	1105	178.0	205.0
	40	57.3	41.0	1092	177.0	200.0
	48	54.7	39.2	1084	177.0	197.0
	UngROUTED	42.0	30.1	1035	178.0	178.0

<sup>1</sup>Section properties are based on net bedded area with cross webs adjacent to grouted cells having mortared bed joints.

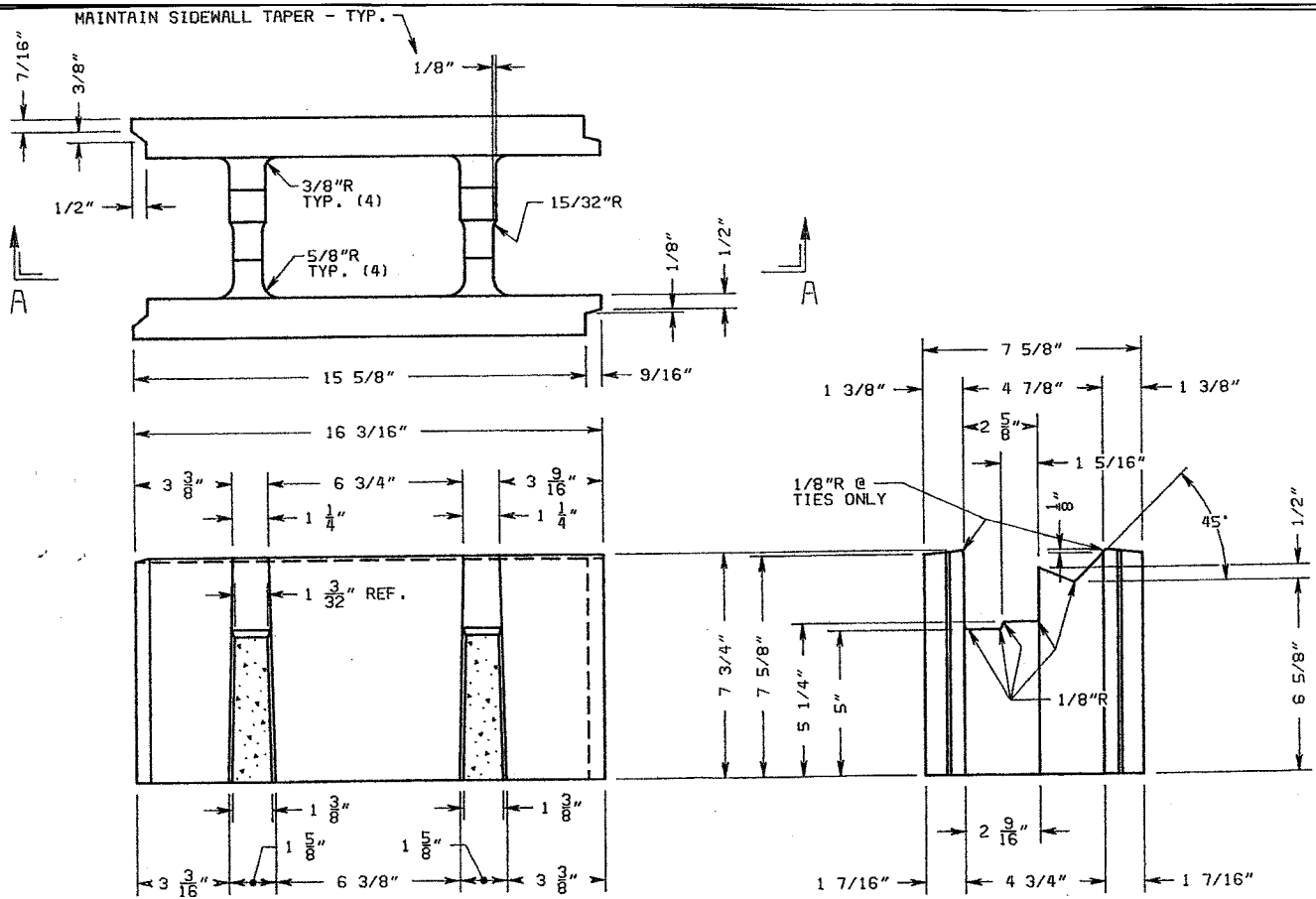


FIGURE NO. 1 8-INCH MASONRY UNIT

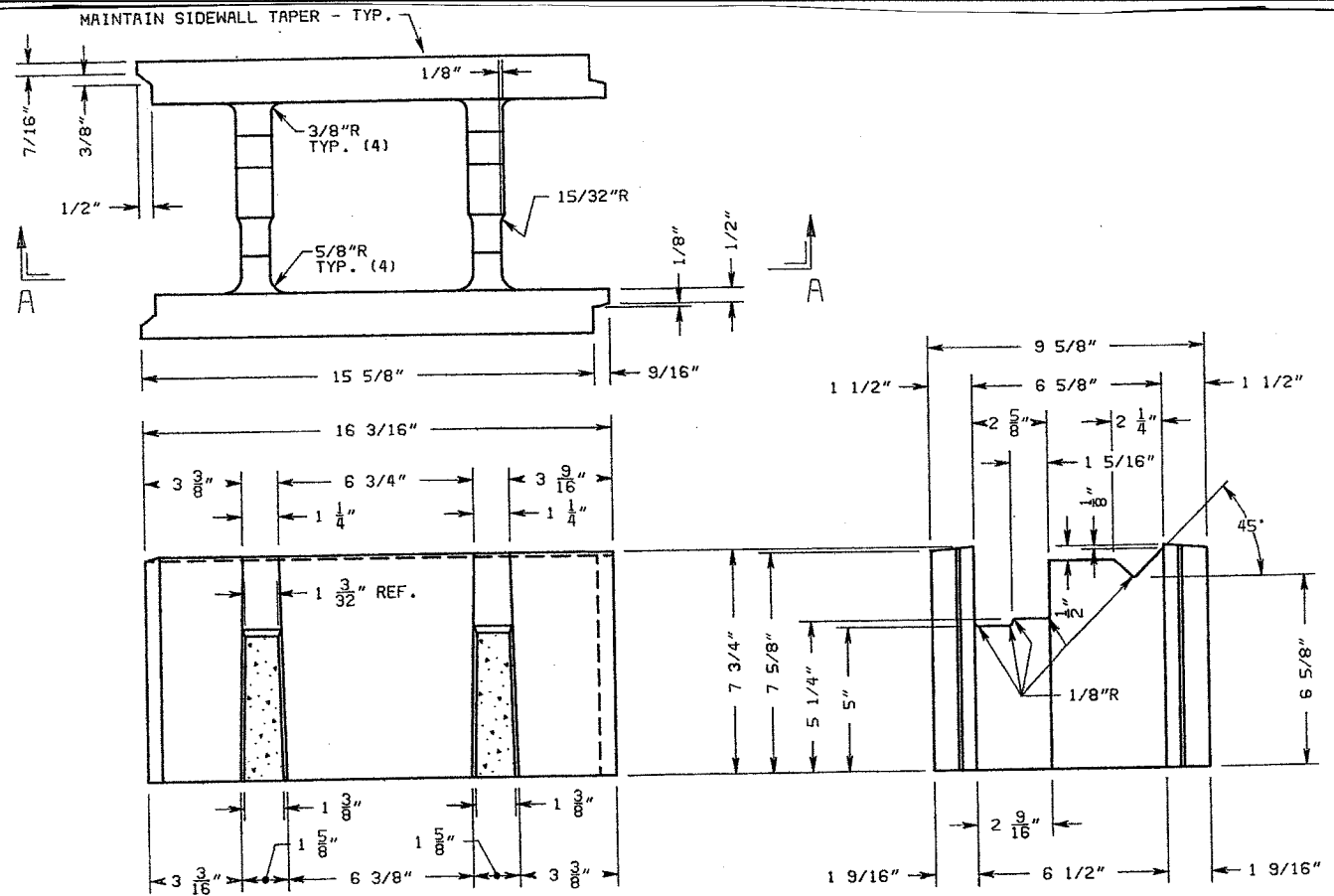


FIGURE NO. 2 10-INCH MASONRY UNIT

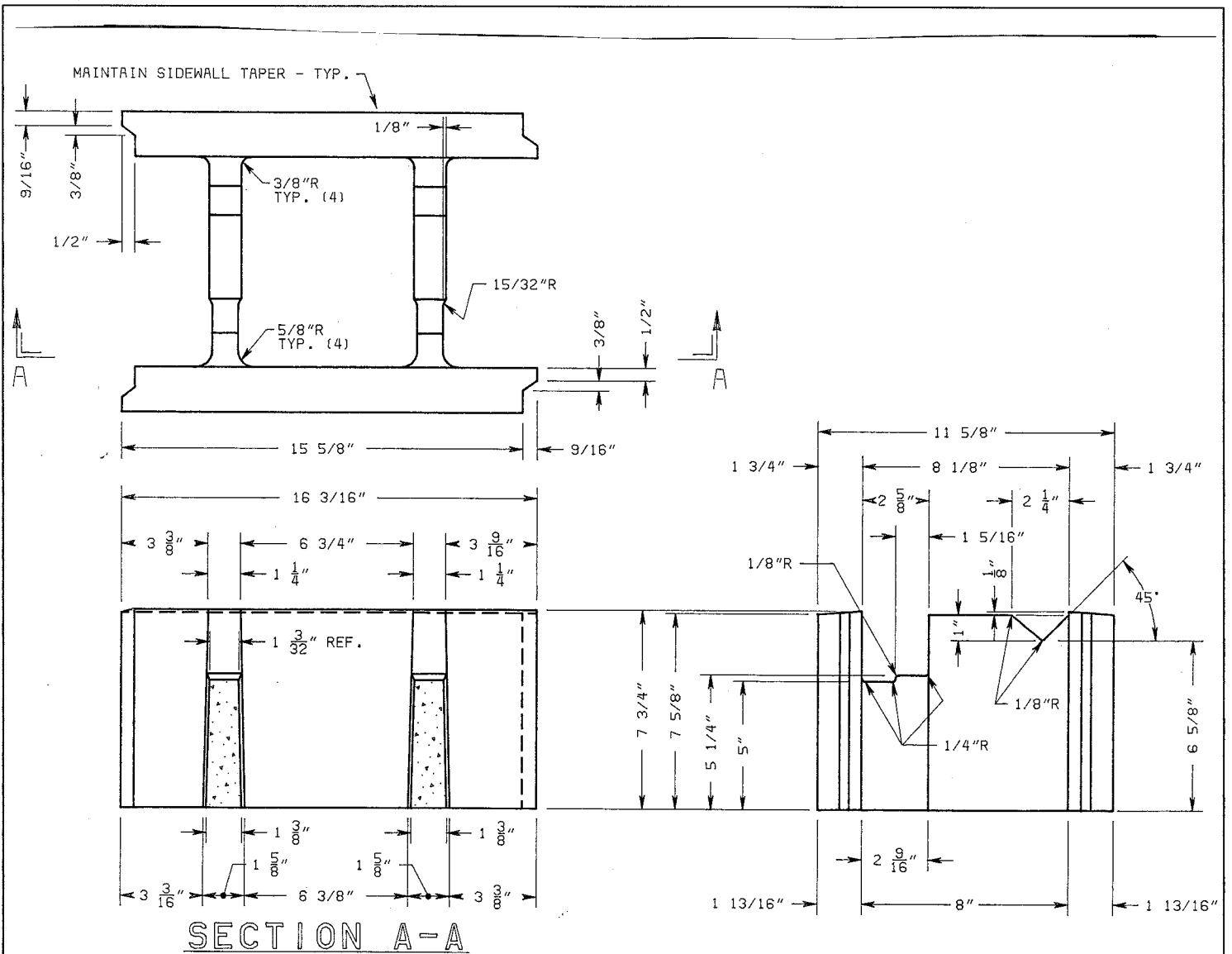


FIGURE NO. 3 12-INCH MASONRY UNIT

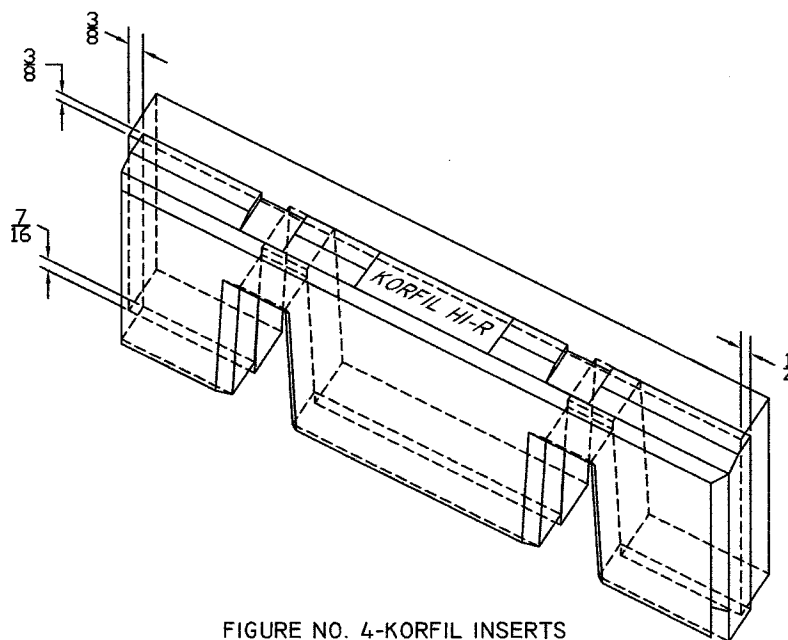
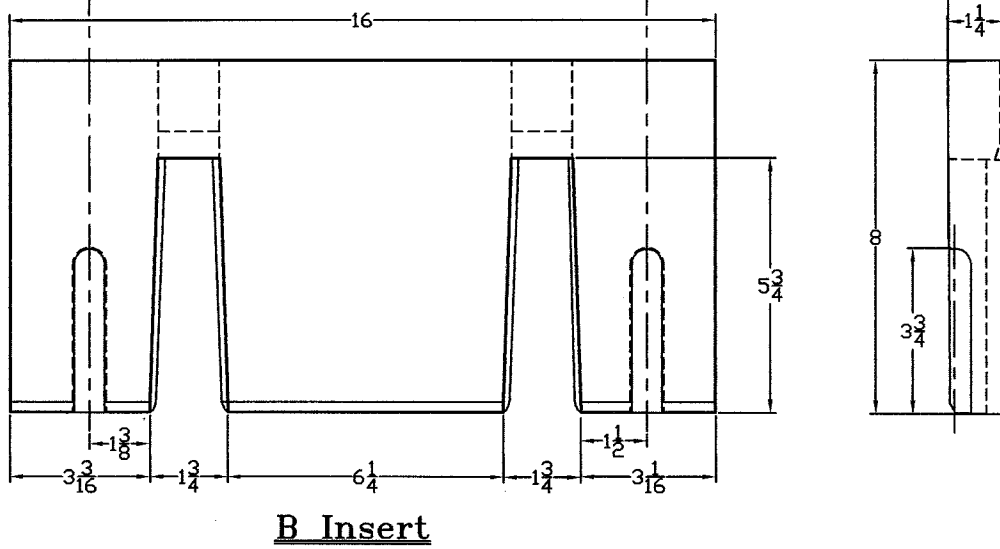
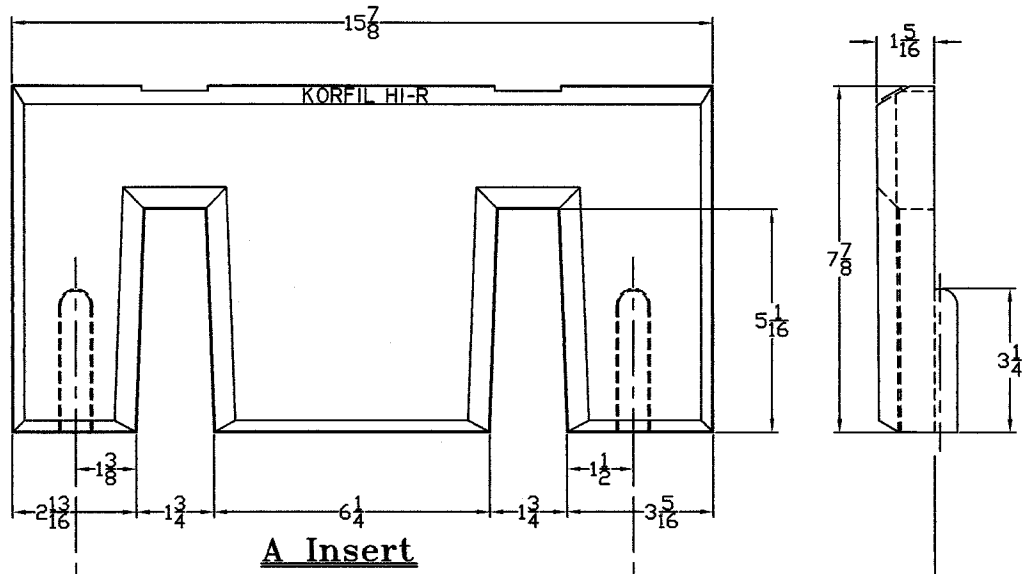


FIGURE NO. 4-KORFIL INSERTS