

**FIRE RATING  
INFORMATION FOR  
INTERIOR  
ACOUSTICAL  
MATERIALS**

Determination of Structural Properties for RPG DiffusorBlox®  
Wall Configurations

Conducted by:



Project Nos. 00-386  
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# Determination of Structural Properties for RPG DiffusorBlox® Wall Configurations

## 1.0 Introduction

This report summarizes the calculations performed by The National Concrete Masonry Association Research and Development Laboratory to determine cross sectional properties of the various *DiffusorBlox*® concrete masonry units supplied by RPG Diffusor Systems, Incorporated.

## 2.0 Scope of Work

Four different DiffusorBlox® Systems were submitted to the NCMA Research and Development Laboratory for determination of cross sectional properties. Each of these wall systems is composed of two alternating units designated A or B. Both eight-inch and twelve-inch nominal wall thicknesses were evaluated. For each wall thickness there were two different systems; one with a slot and one without a slot.

These four systems are designated as shown below:

<u>Designation</u>	<u>Description</u>
DB8S (A or B)	8-inch nominal unit thickness, A and B unit slotted
DB8NS (A or B)	8-inch nominal unit thickness, A and B unit w/o slot
DB12S (A or B)	12-inch nominal unit thickness, A and B unit slotted
DB12NS (A or B)	12-inch nominal unit thickness, A and B unit w/o slot

Each of the above four systems could be grouted in different ways giving rise to several different possible geometric configurations. Each of the possible configurations considered herein is designated below:

<u>Configuration</u>	<u>Description</u>
8 inch Units	
1	DB8NS A and B Unit Grouted Solid
2	DB8S A and B Unit Not Grouted
12 inch Units	
3	DB12NS A and B Units Partially Grouted (Core Only)
4	DB12NS A and B Units Partially Grouted (Between Units Only)
5	DB12NS A and B Units Fully Grouted (Core and Between Units)
6	DB12S A and B Units Partially Grouted (Between Units Only)

For each of the above-designated configurations (6 total) the following geometric properties were determined:

### Cross Sectional Properties Determined for Each Unit

Net Cross Sectional Area,  $A_n$  (in<sup>2</sup>)  
Net Volume,  $V_n$  (ft<sup>3</sup>)  
Equivalent Thickness,  $T_e$  (inches)  
Location of Neutral Axis,  $Y_{\text{bar}}$  (inches)  
Out-of-Plane Moment of Inertia,  $I_x$  (in<sup>4</sup>)  
Out-of-Plane Section Moduli,  $S_{x_{\text{int}}}$  and  $S_{x_{\text{ext}}}$  (in<sup>3</sup>)  
Radius of Gyration,  $r_x$  (inches)

All cross sectional properties were determined using unit dimensions provided in detail CAD drawings supplied to NCMA by RPG, Incorporated. Drawings for each configuration evaluated can be found in Appendix A Figures A-1 and A-2.

### **3.0 Calculation Procedures**

The overall dimensions for each unit were determined from the CAD drawings. Due to the unusual shape and particular features of each unit, certain portions of each cross section were not considered structurally. Guidance for testing concrete masonry units is provided in American Society for Testing and Materials (ASTM) C 140 “Standard Test Method for Sampling and Testing Concrete Masonry Units and Related Units”. This test standard specifically states that projections with a height greater than the thickness should be removed prior to testing the unit in compression. The reason for this is that such projections are considered unsupported. With reference to the structural properties determined for each DiffusorBlox® configuration, all projections falling into the above category were not considered when computing section properties. Appendix A contains drawings for each DiffusorBlox® unit which identify the portions of each unit that were considered structurally depending on the portion of the unit that is or is not grouted solid.

#### 8-Inch Unit Configurations

Figures A-3 and A-4, which refer to the non-slotted 8-inch A and B units, identified as configuration number 1, show the overall unit dimensions as well as the idealized cross section that was used for determining section properties for the grouted system.

Figure A-5, which refers to the slotted 8-inch A and B units, identified as configuration number 2, shows the overall unit dimensions as well as the idealized cross section that was used for determining section properties for the ungrouted 8-inch slotted system. The slotted block configuration does not allow for grouting and therefore the figure shows the units as ungrouted.

#### 12-Inch Unit Configurations

Figures A-6, A-7, A-8, and A-9 all refer to the 12-inch non-slotted A Block. Figure A-6 contains overall dimensions for the non-slotted A unit. Figures A-7 through A-9 contain the idealized cross sections that were assumed for the A unit in configurations 3, 4, and 5 respectively. Figure A-10, A-11, A-12, and A-13 all refer to the 12-inch non-slotted B Block. Figure A-10 contains overall dimensions for the non-slotted B unit. Figures A-11 through A-13 contain the idealized cross sections that were assumed for the B unit in configurations 3, 4, and 5 respectively.

Figures A-14 and A-15 refer to the 12-inch slotted A Block. Figure A-14 contains overall dimensions for the slotted A unit. Figure A-15 contains the idealized cross section that was assumed for the A unit in configuration 6. Figures A-16 and A-17 refer to the 12-inch slotted B Block. Figure A-16 contains overall dimensions for the slotted B unit. Figure A-17 contains the idealized cross section that was assumed for the B unit in configuration 6.

Standards methods of engineering mechanics were employed to determine the required cross sectional properties for each unit.

Table I summarizes the section properties for each unit for each configuration as previously defined. It should be noted that these properties are based on the individual units that make up the designated configuration.

Included in Appendix B (Tables B-1 through B-6) are the calculations for each unit for each configuration. Each set of calculations is labeled accordingly.

**Table I – Cross Sectional Properties for each Unit Configuration**

Unit (A or B)	Neutral Axis (inches) <sup>1</sup>	I <sub>x</sub> (inches <sup>4</sup> )	S <sub>x</sub> (exterior face ) inches <sup>3</sup>	S <sub>x</sub> (interior face ) inches <sup>3</sup>	r <sub>x</sub> (inches)	A <sub>net</sub> (inches <sup>2</sup> )	V <sub>net</sub> (inches <sup>3</sup> )	T <sub>eq</sub> (inches)
<b>Configuration Number 1 → 8-inch non-slotted units A and B (Fully Grouted)</b>								
A	3.36	398	119	144	1.99	100.7	768	6.44
B	2.19	75.1	34.3	19.1	1.26	47.0	358	3.01
<b>Configuration Number 2 → 8-inch slotted units A and B (Ungouted)</b>								
A	3.41	342	100	126	2.40	59.4	453	3.80
B	2.21	69.1	31.3	17.7	1.45	32.8	250	2.10
<b>Configuration Number 3 → 12-inch non-slotted units A and B (Partially Grouted – Between Units Only)</b>								
A	4.91	1444	294	215	3.37	126.8	968	8.12
B	3.46	519	150	106	2.32	96.3	735	6.16
<b>Configuration Number 4 → 12-inch non-slotted units A and B (Partially Grouted – Core Only)</b>								
A	6.58	881	134	175	2.73	118.3	901	7.56
B	5.03	343	68.2	102	2.32	63.7	486	4.08
<b>Configuration Number 5 → 12-inch non-slotted units A and B (Fully Grouted)</b>								
A	5.37	1835	342	293	3.36	163	1242	10.42
B	3.85	642	167	142	2.4	112.8	861	7.22
<b>Configuration Number 6 → 12-inch slotted units A and B (Partially Grouted – Between Units Only)</b>								
A	4.90	1441	294	214	3.39	125.6	959	8.04
B	3.43	498	145	101	2.28	95.8	731	6.13

<sup>1</sup> Neutral axis measured from exterior face of all units



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Report On  
Surface Burning Characteristics  
Determined By  
ASTM E 84 Twenty-Five Foot  
Tunnel Furnace Test Method

PREPARED FOR:  
RPG Diffusor Systems, Inc.  
Upper Marlboro, Maryland

TEST NUMBER T-10965

MATERIAL TESTED:  
Topakustik Panels: Unfinished Grooved  
and Perforated Fire Retardant Treated  
Medium Density Fiberboard

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**I. SCOPE**

This report contains the reference to the test method, purpose, test procedure, round procedures, preparation and conditioning of specimens, description of materials, test observation data, and test results.

**II. TEST METHOD**

The test was conducted in accordance with ASTM E 84, "Standard Test Method for Burning Characteristics of Building Materials." The 25-foot tunnel method is also defined in NFPA 255 and UL 723.

**III. PURPOSE**

The purpose of the test is to determine the relative performance of the test material under a standardized fire exposure. Results are given for Flame Spread and Smoke Developed. The values obtained from burning the test material represent a comparison with that of inorganic reinforced cement board expressed as zero and red oak flooring expressed as 100.

The flame spread results of 25-foot tunnel tests are frequently used by building code and regulatory agencies in the acceptance of interior finish material for various applications. The most widely accepted classification system is epitomized by the National Fire Protection Association Life Safety Code, NFPA 101:

Class A*	0 - 25	flame spread	0-450 smoke developed
Class B*	26 - 75	flame spread	0-450 smoke developed
Class C*	76 - 200	flame spread	0-450 smoke developed

\*Class A, B and C correspond to I, II and III, respectively, in other codes such as the International Building Code and BOCA.

This flame spread classification system is based on the premise that the higher the flame spread numbers, the greater the fire spread potential. The actual relationship between flame spread numbers developed under this test and life safety from fire has not been adequately established.

**IV. TEST PROCEDURE NOTES**

The furnace was preheated to a minimum of 150°F as measured by an 18 AWG thermocouple embedded in cement 1/8" below the floor surface of the chamber, 23-1/4" from the center of the ignition burners. The furnace was then cooled to 105°F (± 5°F) as measured by a thermocouple embedded 1/8" below the floor surface of the test chamber 13' from the center of the ignition burners.

Prior 10-minute tests with 1/4" inorganic reinforced cement board provided the zero reference for flame spread. Periodic 10-minute tests with unfinished select grade red oak flooring provided for the 100 reference for flame spread and smoke developed as noted in Section I.