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**THERMAL RESISTANCE CALCULATIONS OF
NUDURA™ INSULATED CONCRETE FORM WALL SYSTEMS
USING STANDARD ASHRAE THERMAL RESISTANCE VALUES**

A Report to: NUDURA Corporation
Unit 10, 27 Hooper Road,
Barrie, ON
CANADA
L4N 9S3

Attention: Keven Rector
Technical Service Manager

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Proposal No.: 10-006-0774

Report No.: 10-06-M0083 A
4 Pages, 3 Appendices

Date: March 10, 2010

1.0 INTRODUCTION

At the request of NUDURA Corporation, Exova was retained to calculate the theoretical thermal resistance value of several configurations of a wall system using standard theoretical values published in the *ASHRAE Fundamentals Handbook, 2009*.

The modified calculations are based on the client's intentions to insert three different core thicknesses of foam panels in the interior of the concrete cavity with three different exterior finishes on the original "NUDURA™ Insulated Concrete Form Wall System".

The initial calculations and assumptions are shown in the Appendix A: "Bodycote Materials testing Canada Inc., Report No. 01-06-M0379-3 Revision 1". The details of calculations and drawings are shown in Appendix B and C respectively.

The wall systems were assigned the following Exova Identification Nos.:

Client Wall-System Configuration	Exova Identification No.
Exterior finish: Stucco ; 8 inch form insert	09-06-M0291-1A
Exterior finish: Stucco ; 10 inch form insert	09-06-M0291-1B
Exterior finish: Stucco ; 12 inch form insert	09-06-M0291-1C
Exterior finish: Brick ; 8 inch form insert	09-06-M0291-2A
Exterior finish: Brick ; 10 inch form insert	09-06-M0291-2B
Exterior finish: Brick ; 12 inch form insert	09-06-M0291-2C
Exterior finish: Wood ; 8 inch form insert	09-06-M0291-3A
Exterior finish: Wood ; 10 inch form insert	09-06-M0291-3B
Exterior finish: Wood ; 12 inch form insert	09-06-M0291-3C

2.0 PROCEDURE

ASHRAE Fundamentals handbook, 2009, Chapters 23, 25 and 26 were utilized to calculate the theoretical thermal resistance value of the wall systems. In addition, some theoretical values were supplied by the client.

Details of the references are shown below. It should be noted that the values calculated in this report are the apparent value only and may change significantly when used as a system.

Reference Description	Reference No.
Annex 1: Bodycote Materials testing Canada Inc., Report No. 01-06-M0379-3 Revision 1 dated September 21, 2004 originated by Paul Chislom, P.Eng: <i>Thermal Resistance calculations of NUDURA™ Insulated Concrete Form.</i> Except inner and outer insulation thickness 65 mm instead of 63 mm and foam density 1.4 pcf (22.425 kg/m ³) instead of 1.3 pcf (21 kg/m ³); Assumptions: $\lambda=0.035$ instead of 0.036 W/m.K.	1
For stucco, $\lambda=0.25$ W/m.K, Thickness: 5-40 mm, Assumption: thickness of stucco 5 mm, MALEKI Tech Information Sheet, July 2009, document supplied by the client.	2
EPS molded beads, Density: 16.018 Kg/m ³ . For 15-25 Kg/m ³ , $\lambda=0.032$ to 0.039 W/m.K, Thickness 8, 10 and 12 inch. Assumptions: $\lambda=0.038$ W/m.K	3
ASHRAE 26.7, Table 4, Density 1760: kg/m ³ , Conductivity 0.71 to 0.85 W/m.K, Assumptions: Thickness 100 mm, $\lambda=0.77$ W/m.K	4
ASHRAE 26.3, Table 2, 3; Position of air space: Vertical Direction of Heat Flow: Horizontal, Assumptions: Mean temperature: 10 °C, $\Delta T=16.7K$, $\epsilon=0.82$, Air space ½ inch, R value: 0.16 m ² K/W.	5
ASHRAE 26.5, Siding, Wood, bevel: 200 mm, lapped 13 mm, R value 0.14 m ² K/W	6
ASHRAE 26.3, Table 2, 3; Position of air space: Vertical Direction of Heat Flow: Horizontal, Assumptions: Mean temperature: 10 °C, $\Delta T=16.7K$, $\epsilon=0.82$, Air space 1.5 inch, R value: 0.18 m ² K/W	7

3.0 RESULTS

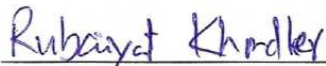
A summary of results is presented below in Table1. A detailed presentation of the values used in the total thermal resistance calculation is provided in Appendix B. In all cases, SI units are the primary units of measure.

Table 1 – Summary of Theoretical Thermal Transmission Values Exova Identification No.: 10-06-M0083 A			
Configuration	Total Thermal Resistance		
	R-value °F.ft ² .h/Btu	RSI-value m ² K/W	U-value W/m ² K
09-06-M0291-1A Stucco & 8in. Form Insert	31.857	5.614	0.180
09-06-M0291-1B Stucco & 10in. Form Insert	38.869	6.852	0.149
09-06-M0291-1C Stucco & 12in. Form Insert	45.881	8.081	0.128
09-06-M0291-2A Brick & 8in. Form Insert	33.457	5.884	0.171
09-06-M0291-2B Brick & 10in. Form Insert	40.469	7.122	0.143
09-06-M0291-2C Brick & 12in. Form Insert	47.481	8.351	0.124
09-06-M0291-3A Wood & 8in. Form Insert	33.557	5.914	0.170
09-06-M0291-3B Wood & 10in. Form Insert	40.569	7.152	0.142
09-06-M0291-3C Wood & 12in. Form Insert	47.581	8.381	0.123

4.0 CONCLUSION

The specified system configurations of NUDURA™ Insulated Concrete Form Wall Systems, as provided in this report, have theoretical thermal resistance values as shown in Table 1, calculated based on standard ASHRAE thermal resistance values.

Reported by:



Rubaiyat Khondker, P.Eng., Ext 662
Project Engineer, Building Performance Centre
Product Technologies Group

Approved by:



Franz Bauer, Ext. 403
Manager, Building Performance Centre
Product Technologies Group

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APPENDIX A

Bodycote Materials testing Canada Inc.,
Report No. 01-06-M0379-3 Revision 1

Thermal Resistance Calculations of NUDURA™ Insulated Concrete Form

(2 Pages)

September 21, 2004.

Mr. Keven Rector, Technical Services Manager
NUDURA Corporation
80 Ellis Drive, Unit. No. 1
Barrie, Ontario L4N 8Z3

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Email: keven@nudura.com

Dear Mr. Rector:

Re: Thermal Resistance Calculations of NUDURA™ Insulated Concrete Form
Report No. 01-06-M0379-3 Revision 1

As requested, we have performed a calculation to determine the thermal resistance (R-value) of a typical installation of a NUDURA wall system.

The calculations were performed in accordance with Chapters 23 and 25 of the 2001 ASHRAE Fundamentals Handbook. The NUDURA insulated concrete form system consists of two panels of expanded polystyrene connected together with hinging polypropylene webs at 8-in. (200 mm) on center. The 2 3/8-in. (61 mm) insulated panels have rows of dovetailed keys having an average thickness of 1/2-in. (12.5 mm) and depth of 1/4-in. (6 mm). The resulting effective thickness of each panel is 2.5-in. (63 mm). The assumed density of the panels is 1.3 pcf (21 kg/m³) with a corresponding thermal resistivity of 4 °F ft²·hr./Btu·in. (27.73 m.K/W) (The effectiveness of the concrete core is 6 7/16-in. (163 mm) and the thermal resistivity was assumed to be 0.09 °F ft²·hr./Btu·in. (0.624 m.K/W).

The webs connecting the insulating panels are high density polypropylene and are spaced every 8-in. (200 mm). These webs penetrate the concrete in the finished system. Due to the small cross-section and the thermal properties of the plastic, the thermal effect of the webs is not significant and was excluded from the calculation.

Table 1, below, summarizes the thermal calculations.

Component	Thermal Resistance	
	hr·ft ² ·°F/Btu	m ² ·K/W
Outdoor Film (Winter condition)	0.17	0.029
Siding (Hollow backed vinyl/steel)	0.61	0.107
Outer Insulation Panel	9.94	1.750
Concrete Core	0.58	0.102
Inner Insulation Panel	9.94	1.750
Gypsum Wallboard	0.45	0.080
Indoor Film	0.68	0.120
Total R-Value / RSI	22.4	3.94

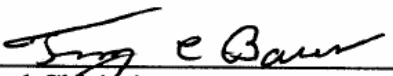
Table 1 – Thermal resistance calculations for NUDURA™ wall system.

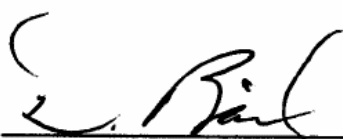
The total thermal resistance (R-value) of the assumed wall is 22.4 hr·ft²·°F/Btu (3.94 m²·K/W). The thermal transmittance (U-factor) is the inverse of the total R-value and is equal to 0.0447 Btu/hr·ft²·°F (0.2538 W/m²K).

The total thermal resistance values can be increased if exterior cladding materials of greater thermal resistance are used. For example ¾" x 10" (19mm x 250mm) beveled wood siding would have a thermal resistance of 1.052 °F· ft²· hr./Btu (0.185 m²·K/W) thus increasing the overall resistance to 23.5 °F· ft²· hr./Btu (4.125 m²·K/W).

We trust that this presents the information you require.

Sincerely,


Paul Chisholm, MA. Sc., P.Eng
Project Engineer
Building Performance, Material Technologies


David W. Bailey, P.Eng.
Operations Manager
Material Technologies

APPENDIX B

Details Presentation of Calculated Results

(10 Pages)

Table 1A – Exterior Finish: Stucco; 8 inch Form Insert Through Insulation Exova Identification No.: 09-06-M0291-1A				
Component Name	Thickness mm	RSI Value m ² K/W	R Value °F.ft ² .h/Btu	Reference
Outdoor film	-	0.029	0.17	1
Stucco	5	0.02	0.11	2
Outer Insulation Panel	65	1.86	10.55	1
Concrete Core	163	0.102	0.58	1
EPS foam insert	63.5	1.67	9.49	3
Inner Insulation Panel	65	1.86	10.55	1
Gypsum wall board	-	0.08	0.45	1
Indoor film	-	0.12	0.68	1
Total	R	5.74 m ² K/W	32.58 °F.ft ² .h/Btu	
	U	0.174 W/m ² K	0.036Btu/°F.ft ² .h	

Table 1A' – Exterior Finish: Stucco; EPS Foam Insert: 8 inch Form Insert Through Spline Exova Identification No.: 09-06-M0291-1A'				
Component Name	Thickness mm	RSI Value m ² K/W	R Value °F.ft ² .h/Btu	Reference
Outdoor film	-	0.029	0.17	1
Stucco	5	0.02	0.11	2
Outer Insulation Panel	65	1.86	10.55	1
Concrete Core	226.5	0.14	0.8	1
EPS foam insert				
Inner Insulation Panel	65	1.86	10.55	1
Gypsum wall board	-	0.08	0.45	1
Indoor film	-	0.12	0.68	1
Total	R	4.109 m ² K/W	23.310 °F.ft ² .h/Btu	
	U	0.243 W/m ² K	0.0429 Btu/°F.ft ² .h	

Table 1B – Exterior finish: Stucco, EPS foam insert: 10 inch Form Insert Through Insulation				
Exova Wall System Name: 09-06-M0291-1B				
Component Name	Thickness mm	RSI value m²K/W	R value °F.ft².h/Btu	Reference
Outdoor film	-	0.029	0.17	1
Stucco	5	0.02	0.11	2
Outer Insulation Panel	65	1.86	10.55	1
Concrete Core	163	0.102	0.58	1
EPS foam insert	114.3	3.01	17.08	3
Inner Insulation Panel	65	1.86	10.55	1
Gypsum wall board	-	0.08	0.45	1
Indoor film	-	0.12	0.68	1
Total	R	7.081 m ² K/W	40.17 °F.ft ² .h/Btu	
	U	0.141 W/m ² K	0.02489 Btu/°F.ft ² .h	

Table 1B' – Exterior finish: Stucco, EPS foam insert: 10 inch Form Insert Through Spline				
Exova Wall System Name: 09-06-M0291-1B'				
Component Name	Thickness mm	RSI value m²K/W	R value °F.ft².h/Btu	Reference
Outdoor film	-	0.029	0.17	1
Stucco	5	0.02	0.11	2
Outer Insulation Panel	65	1.86	10.55	1
Concrete Core	277.3	0.17	0.98	1
EPS foam insert				
Inner Insulation Panel	65	1.86	10.55	1
Gypsum wall board	-	0.08	0.45	1
Indoor film	-	0.12	0.68	1
Total	R	4.139 m ² K/W	23.49 °F.ft ² .h/Btu	
	U	0.242 W/m ² K	0.04257 Btu/°F.ft ² .h	

Table 1C – Exterior finish: Stucco, EPS foam insert: 12 inch Form Insert Through Insulation Exova Wall System Name: 09-06-M0291-1C				
Component Name	Thickness mm	RSI value m ² K/W	R value °F.ft ² .h/Btu	Reference
Outdoor film	-	0.029	0.17	1
Stucco	5	0.02	0.11	2
Outer Insulation Panel	65	1.86	10.55	1
Concrete Core	163	0.102	0.58	1
EPS foam insert	165.1	4.34	24.67	3
Inner Insulation Panel	65	1.86	10.55	1
Gypsum wall board	-	0.08	0.45	1
Indoor film	-	0.12	0.68	1
Total	R	8.411 m ² K/W	47.76 °F.ft ² .h/Btu	
	U	0.119 W/m ² K	0.0209 Btu/°F.ft ² .h	

Table 1C' – Exterior finish: Stucco, EPS foam insert: 12 inch Form Insert Through Spline Exova Wall System Name: 09-06-M0291-1C'				
Component Name	Thickness mm	RSI value m ² K/W	R value °F.ft ² .h/Btu	Reference
Outdoor film	-	0.029	0.17	1
Stucco	5	0.02	0.11	2
Outer Insulation Panel	65	1.86	10.55	1
Concrete Core	328	0.21	1.16	1
EPS foam insert				
Inner Insulation Panel	65	1.86	10.55	1
Gypsum wall board	-	0.08	0.45	1
Indoor film	-	0.12	0.68	1
Total	R	4.179 m ² K/W	23.67 °F.ft ² .h/Btu	
	U	0.239 W/m ² K	0.0422 Btu/°F.ft ² .h	

Table 2A – Exterior finish: Brick, EPS foam insert: 8 inch Form Insert Through Insulation				
Exova Wall System Name: 09-06-M0291-2A				
Component Name	Thickness mm	RSI value m²K/W	R value °F.ft².h/Btu	Reference
Outdoor film	-	0.029	0.17	1
Clay Brick	100	0.13	0.8	4
Air space (1/2 inch)	13	0.16	0.91	5
Outer Insulation Panel	65	1.86	10.55	1
Concrete Core	163	0.102	0.58	1
EPS foam insert	63.5	1.67	9.49	3
Inner Insulation Panel	65	1.86	10.55	1
Gypsum wall board	-	0.08	0.45	1
Indoor film	-	0.12	0.68	1
Total	R	6.011 m ² K/W	34.180 °F.ft ² .h/Btu	
	U	0.166 W/m ² K	0.0413 Btu/°F.ft ² .h	

Table 2A' – Exterior finish: Brick, EPS foam insert: 8 inch Form Insert Through Spline				
Exova Wall System Name: 09-06-M0291-2A'				
Component Name	Thickness mm	RSI value m²K/W	R value °F.ft².h/Btu	Reference
Outdoor film	-	0.029	0.17	1
Clay Brick	100	0.13	0.8	4
Air space (1/2 inch)	13	0.16	0.91	5
Outer Insulation Panel	65	1.86	10.55	1
Concrete Core	226.5	0.14	0.8	
EPS foam insert	-	-	-	
Inner Insulation Panel	65	1.86	10.55	1
Gypsum wall board	-	0.08	0.45	1
Indoor film	-	0.12	0.68	1
Total	R	4.379 m ² K/W	24.91 °F.ft ² .h/Btu	
	U	0.228 W/m ² K	0.0401 Btu/°F.ft ² .h	

Table 2B – Exterior finish: Brick, EPS foam insert: 10 inch Form Insert Through Insulation				
Exova Wall System Name: 09-06-M0291-2B				
Component Name	Thickness mm	RSI value m²K/W	R value °F.ft².h/Btu	Reference
Outdoor film		0.029	0.17	1
Clay Brick	100	0.13	0.8	4
Air space (1/2 inch)	13	0.16	0.91	5
Outer Insulation Panel	65	1.86	10.55	1
Concrete Core	163	0.102	0.58	1
EPS foam insert	114.3	3.01	17.08	3
Inner Insulation Panel	65	1.86	10.55	1
Gypsum wall board		0.08	0.45	1
Indoor film		0.12	0.68	1
Total	R	7.351 m ² K/W	41.77 °F.ft ² .h/Btu	
	U	0.136 W/m ² K	0.0239 Btu/°F.ft ² .h	

Table 2B' – Exterior finish: Brick, EPS foam insert: 10 inch Form Insert Through Spline				
Exova Wall System Name: 09-06-M0291-2B'				
Component Name	Thickness mm	RSI value m²K/W	R value °F.ft².h/Btu	Reference
Outdoor film		0.029	0.17	1
Clay Brick	100	0.13	0.8	4
Air space (1/2 inch)	13	0.16	0.91	5
Outer Insulation Panel	65	1.86	10.55	1
Concrete Core	277.3	0.17	0.98	1
EPS foam insert	-	-	-	3
Inner Insulation Panel	65	1.86	10.55	1
Gypsum wall board		0.08	0.45	1
Indoor film		0.12	0.68	1
Total	R	4.409 m ² K/W	25.09 °F.ft ² .h/Btu	
	U	0.227 W/m ² K	0.0398 Btu/°F.ft ² .h	

Table 2C – Exterior finish: Brick, EPS foam insert: 12 inch Form Insert Through Insulation				
Exova Wall System Name: 09-06-M0291-2C				
Component Name	Thickness mm	RSI value m²K/W	R value °F.ft².h/Btu	Reference
Outdoor film		0.029	0.17	1
Clay Brick	100	0.13	0.8	4
Air space (1/2 inch)	13	0.16	0.91	5
Outer Insulation Panel	65	1.86	10.55	1
Concrete Core	163	0.102	0.58	1
EPS foam insert	165.1	4.34	24.67	3
Inner Insulation Panel	65	1.86	10.55	1
Gypsum wall board		0.08	0.45	1
Indoor film		0.12	0.68	1
Total	R	8.681 m ² K/W	49.36 °F.ft ² .h/Btu	
	U	0.115 W/m ² K	0.0202 Btu/°F.ft ² .h	

Table 2C' – Exterior finish: Brick, EPS foam insert: 12 inch Form Insert Through Spline				
Exova Wall System Name: 09-06-M0291-2C'				
Component Name	Thickness mm	RSI value m²K/W	R value °F.ft².h/Btu	Reference
Outdoor film		0.029	0.17	1
Clay Brick	100	0.13	0.8	4
Air space (1/2 inch)	13	0.16	0.91	5
Outer Insulation Panel	65	1.86	10.55	1
Concrete Core	328	0.21	1.16	1
EPS foam insert	-	-	-	3
Inner Insulation Panel	65	1.86	10.55	1
Gypsum wall board		0.08	0.45	1
Indoor film		0.12	0.68	1
Total	R	4.449 m ² K/W	25.27 °F.ft ² .h/Btu	
	U	0.225 W/m ² K	0.0395 Btu/°F.ft ² .h	

Table 3A – Exterior finish: Wood, EPS foam insert: 8 inch Form Insert Through Insulation				
Exova Wall System Name: 09-06-M0291-3A				
Component Name	Thickness mm	RSI value m²K/W	R value °F.ft².h/Btu	Reference
Outdoor film		0.029	0.17	1
Wood		0.14	0.79	6
Air space (1.5 inch)	40	0.18	1.02	7
Outer Insulation Panel	65	1.86	10.55	1
Concrete Core	163	0.102	0.58	1
EPS foam insert	63.5	1.67	9.49	3
Inner Insulation Panel	65	1.86	10.55	1
Gypsum wall board		0.08	0.45	1
Indoor film		0.12	0.68	1
Total	R	6.041 m ² K/W	34.28 °F.ft ² .h/Btu	
	U	0.166 W/m ² K	0.0291 Btu/°F.ft ² .h	

Table 3A' – Exterior finish: Wood, EPS foam insert: 8 inch Form Insert Through Spinel				
Exova Wall System Name: 09-06-M0291-3A'				
Component Name	Thickness mm	RSI value m²K/W	R value °F.ft².h/Btu	Reference
Outdoor film		0.029	0.17	1
Wood		0.14	0.79	6
Air space (1.5 inch)	40	0.18	1.02	7
Outer Insulation Panel	65	1.86	10.55	1
Concrete Core	226.5	0.14	0.8	1
EPS foam insert	-	-	-	3
Inner Insulation Panel	65	1.86	10.55	1
Gypsum wall board		0.08	0.45	1
Indoor film		0.12	0.68	1
Total	R	4.409 m ² K/W	25.01 °F.ft ² .h/Btu	
	U	0.227 W/m ² K	0.0399 Btu/°F.ft ² .h	

Table 3B – Exterior finish: Wood, EPS foam insert: 10 inch Form Insert Through Insulation				
Exova Wall System Name: 09-06-M0291-3B				
Component Name	Thickness mm	RSI value m²K/W	R value °F.ft².h/Btu	Reference
Outdoor film		0.029	0.17	1
Wood		0.14	0.79	6
Air space (1.5 inch)	40	0.18	1.02	7
Outer Insulation Panel	65	1.86	10.55	1
Concrete Core	163	0.102	0.58	1
EPS foam insert	114.3	3.01	17.08	3
Inner Insulation Panel	65	1.86	10.55	1
Gypsum wall board		0.08	0.45	1
Indoor film		0.12	0.68	1
Total	R	7.381 m ² K/W	41.870 °F.ft ² .h/Btu	
	U	0.135 W/m ² K	0.02388 Btu/°F.ft ² .h	

Table 3B' – Exterior finish: Wood, EPS foam insert: 10 inch Form Insert Through Spline				
Exova Wall System Name: 09-06-M0291-3B'				
Component Name	Thickness mm	RSI value m²K/W	R value °F.ft².h/Btu	Reference
Outdoor film		0.029	0.17	1
Wood		0.14	0.79	6
Air space (1.5 inch)	40	0.18	1.02	7
Outer Insulation Panel	65	1.86	10.55	1
Concrete Core	277.3	0.17	0.98	1
EPS foam insert	-	-	-	3
Inner Insulation Panel	65	1.86	10.55	1
Gypsum wall board		0.08	0.45	1
Indoor film		0.12	0.68	1
Total	R	4.439 m ² K/W	25.19 °F.ft ² .h/Btu	
	U	0.225 W/m ² K	0.0396 Btu/°F.ft ² .h	

Table 3C – Exterior finish: Wood, EPS foam insert: 12 inch Form Insert Through Insulation				
Exova Wall System Name: 09-06-M0291-3C				
Component Name	Thickness mm	RSI value m²K/W	R value °F.ft².h/Btu	Reference
Outdoor film		0.029	0.17	1
Wood		0.14	0.79	6
Air space (1.5 inch)	40	0.18	1.02	7
Outer Insulation Panel	65	1.86	10.55	1
Concrete Core	163	0.102	0.58	1
EPS foam insert	165.1	4.34	24.67	3
Inner Insulation Panel	65	1.86	10.55	1
Gypsum wall board		0.08	0.45	1
Indoor film		0.12	0.68	1
Total	R	8.711 m ² K/W	49.46 °F.ft ² .h/Btu	
	U	0.115 W/m ² K	0.0202 Btu/°F.ft ² .h	

Table 3C' – Exterior finish: Wood, EPS foam insert: 12 inch Form Insert Through Spline				
Exova Wall System Name: 09-06-M0291-3C'				
Component Name	Thickness mm	RSI value m²K/W	R value °F.ft².h/Btu	Reference
Outdoor film		0.029	0.17	1
Wood		0.14	0.79	6
Air space (1.5 inch)	40	0.18	1.02	7
Outer Insulation Panel	65	1.86	10.55	1
Concrete Core	328	0.21	1.16	1
EPS foam insert	-	-	-	3
Inner Insulation Panel	65	1.86	10.55	1
Gypsum wall board		0.08	0.45	1
Indoor film		0.12	0.68	1
Total	R	4.479 m ² K/W	25.37 °F.ft ² .h/Btu	
	U	0.223 W/m ² K	0.0394 Btu/°F.ft ² .h	

Table 4: Summary of the corrected data to compensate the allowance for the critical bridge associated with the plastic web and the concrete fines that will fill between the insulation panel inserts and the plastic web.

Wall system	R	Corrected R	RSI	Corrected RSI	U	Corrected U
1A	32.580	30.039	5.741	5.293	0.174	0.161
1A'	23.310	1.818	4.109	0.321	0.243	0.019
		31.857		5.614		0.180
1B	40.170	37.037	7.081	6.529	0.141	0.130
1B'	23.490	1.832	4.139	0.323	0.242	0.019
		38.869		6.852		0.149
1C	47.760	44.035	8.411	7.755	0.119	0.110
1C'	23.670	1.846	4.179	0.326	0.239	0.019
		45.881		8.081		0.128
2A	34.180	31.514	6.011	5.542	0.166	0.153
2A'	24.910	1.943	4.379	0.342	0.228	0.018
		33.457		5.884		0.171
2B	41.770	38.512	7.351	6.778	0.136	0.125
2B'	25.090	1.957	4.409	0.344	0.227	0.018
		40.469		7.122		0.143
2C	49.360	45.510	8.681	8.004	0.115	0.106
2C'	25.270	1.971	4.449	0.347	0.225	0.018
		47.481		8.351		0.124
3A	34.280	31.606	6.041	5.570	0.166	0.153
3A'	25.010	1.951	4.409	0.344	0.227	0.018
		33.557		5.914		0.170
3B	41.870	38.604	7.381	6.805	0.135	0.125
3B'	25.190	1.965	4.439	0.346	0.225	0.018
		40.569		7.152		0.142
3C	49.460	45.602	8.711	8.032	0.115	0.106
3C'	25.370	1.979	4.479	0.349	0.223	0.017
		47.581		8.381		0.123

Please note:

The total values for thermal resistance (R - value) or thermal conductance (U - value) include an allowance for the thermal bridge associated with the plastic web and concrete fines that will fill the voids between the insulation panel inserts and the plastic web. As supplied by Nudura the gap at each web is approximately 5/8 inch wide and the webs are spaced at 8 inch oc. Nudura's calculations, as provided, state that the gap (thermal bridge) represents 7.8% of the total area leaving 92.2% of the wall area unaffected by the thermal bridge. For calculation purposes the thermal bridge is assigned an R - value equivalent to concrete.

APPENDIX C

Detail Drawings of Wall system (supplied by NUDURA)
(6 Pages)

N-1 (12 Standard Format Unit-A-1 LT SCALE 12)

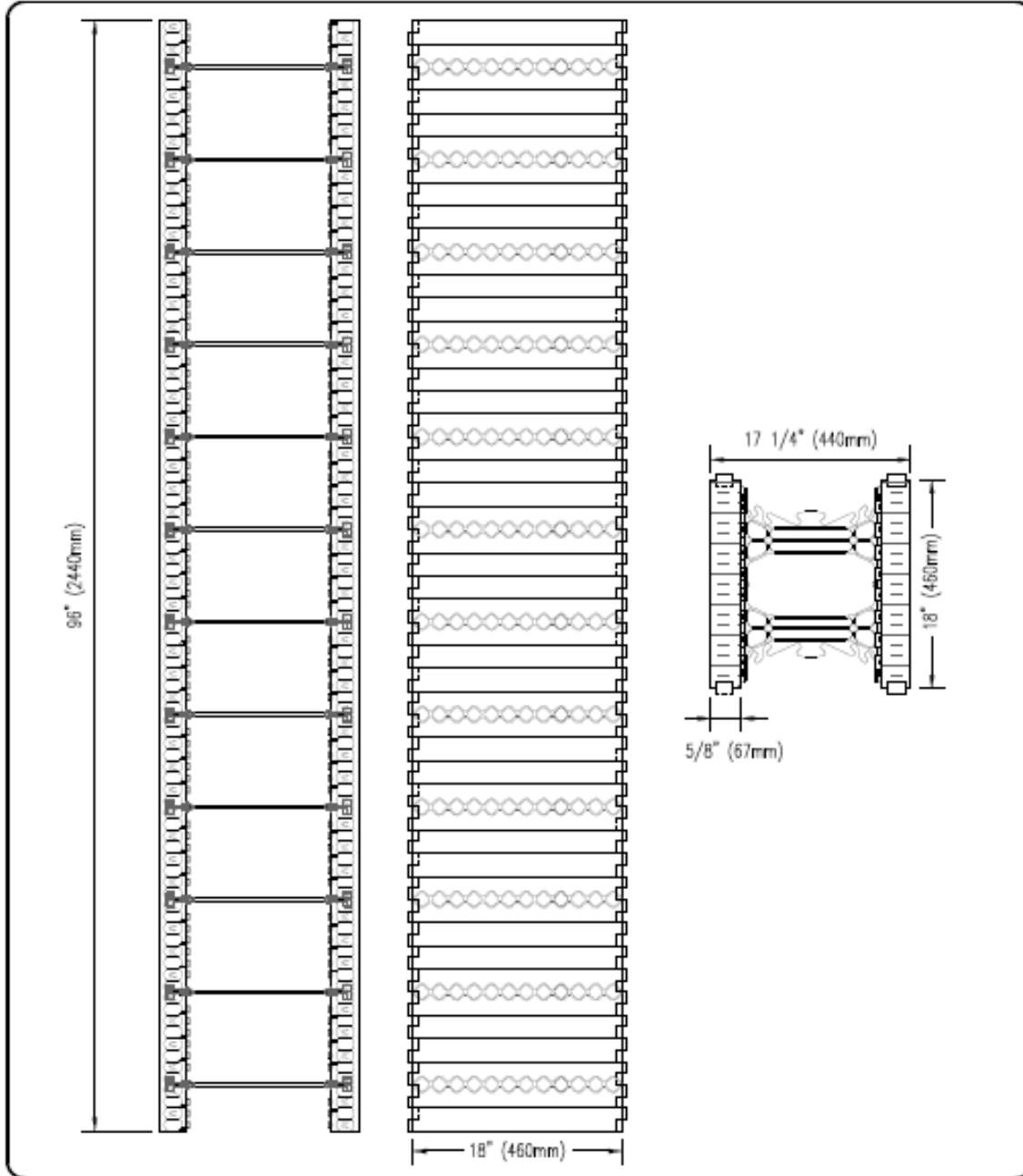
FIB-05 Form Insert for 08 Inch Core Form

FIB-06 Form Insert for 08 Inch Core Form *

N-1 (10 Standard Format Unit-A-1 LT SCALE 12)

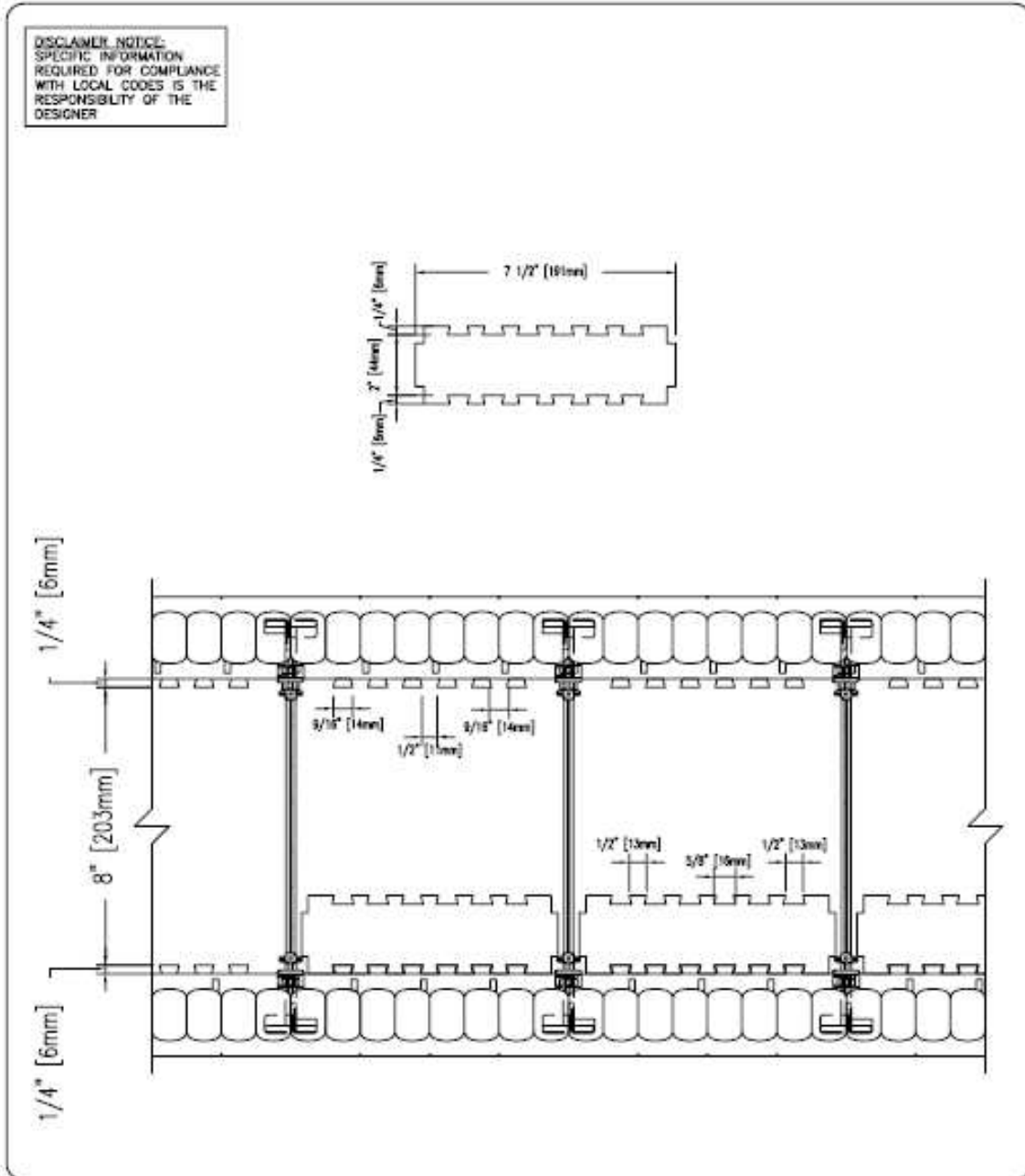
FIB-03 Form Insert for 12 Inch Core Form

N-1 (8 Standard Format Unit-A-1 LT SCALE 12(1))



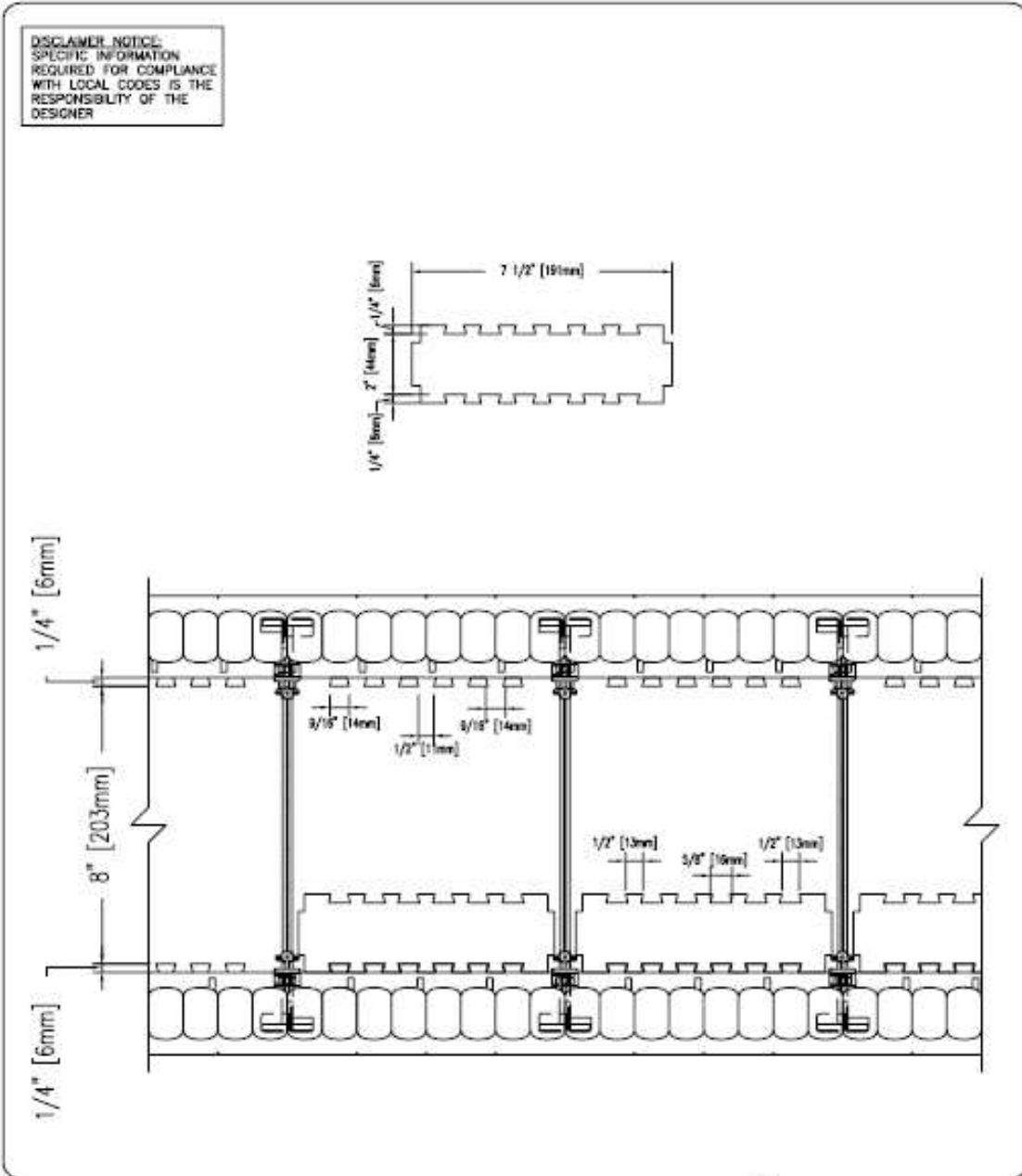
STANDARD 12" FORM UNIT

REV. NO. 002 TV	DWG. NO. N-12-1
REV. DATE 09/01/08	
DRAWN BY: J. NEILON	SCALE: 1" = 1'-0"



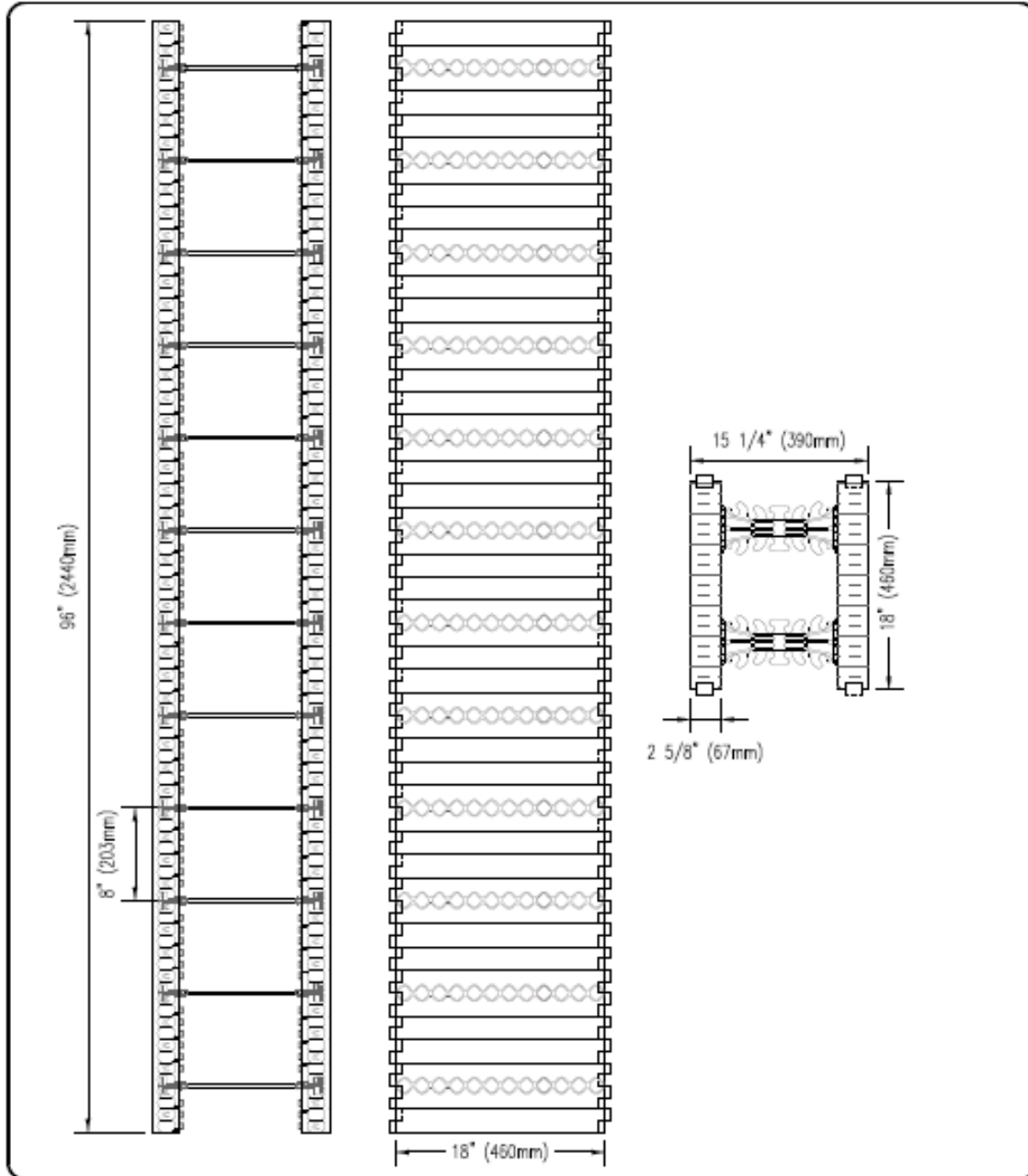
DETAIL PLAN VIEW
NUDURA FOAM INSERT BILLET FOR
8" CONCRETE CORE FORM

REV. NO. 001 KS	DWG. NO. FIB-05
DATE JUNE 2009	
DRAWN BY: K. STILL	SCALE: 3"=1'-0"

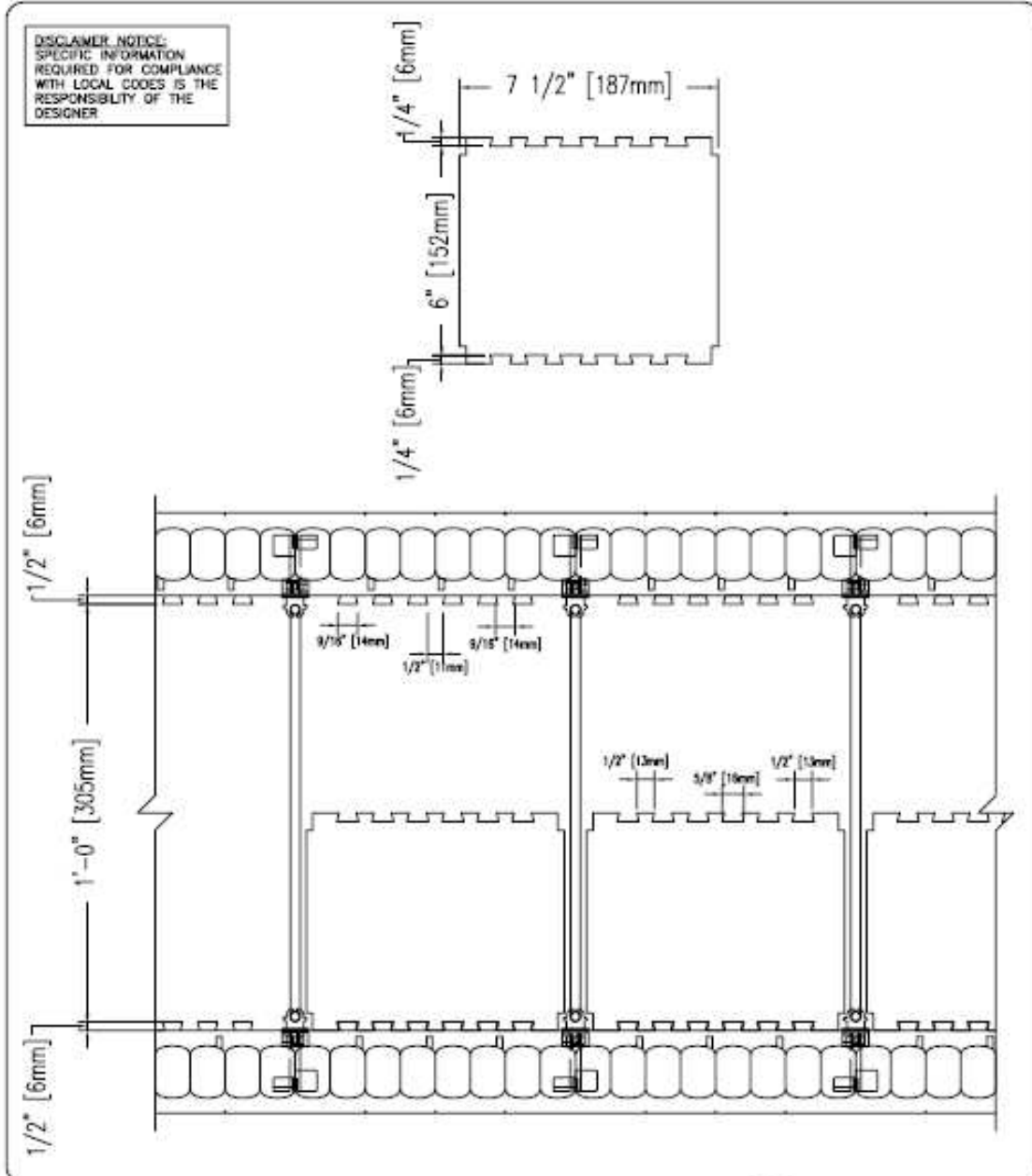


DETAIL PLAN VIEW
NUDURA FOAM INSERT BILLET FOR
8" CONCRETE CORE FORM

REV. NO. 001 KS	DWG. NO. FIB-05
DATE JUNE 2009	SCALE: 3"=1'-0"
DRAWN BY: K. STILL	

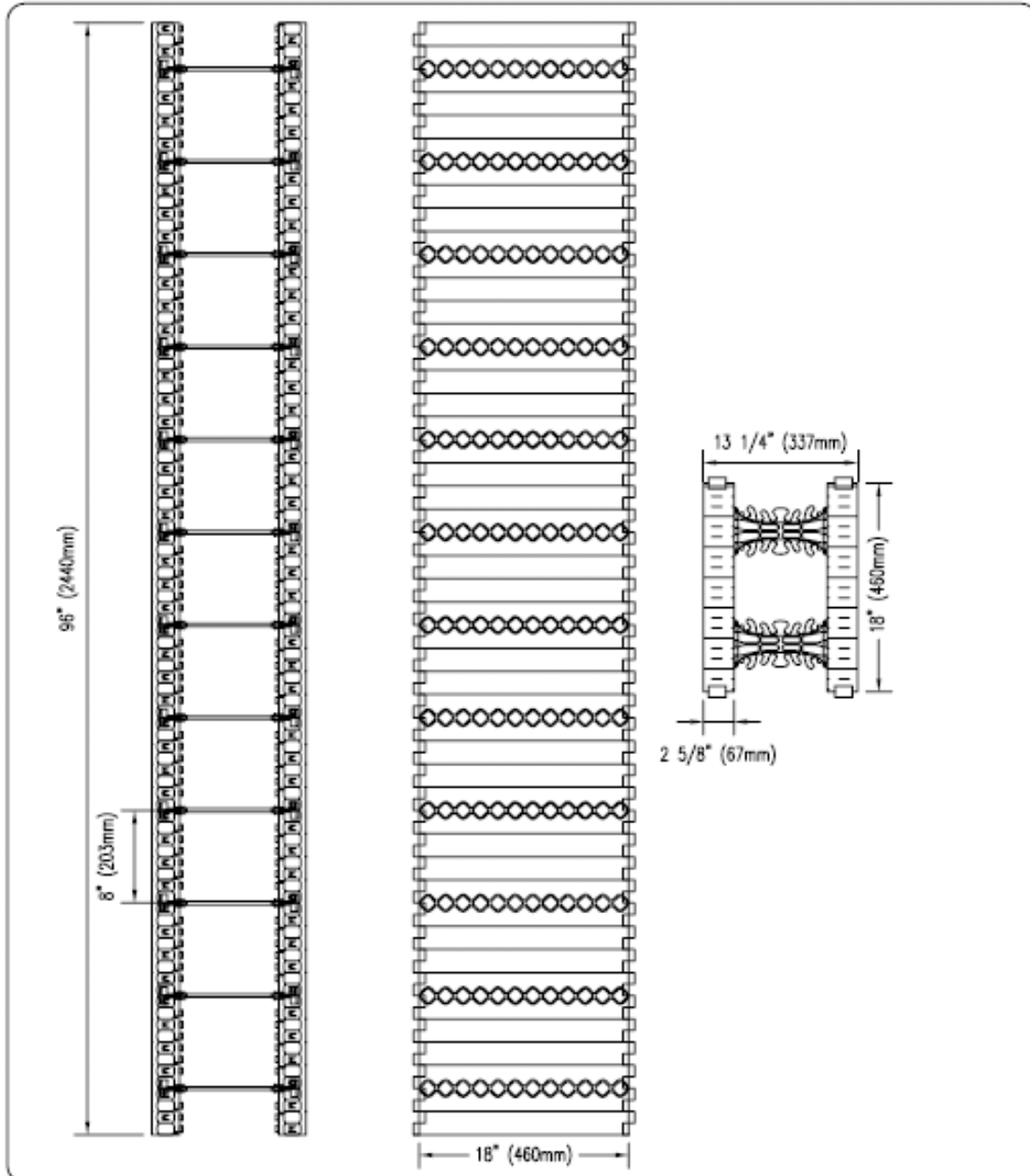


STANDARD 10" FORM UNIT	
REV. NO. 002 TV	DWG. NO. N-10-1
REV. DATE 09/01/08	SCALE 1" = 1'-0"
DRAWN BY: J. NELSON	



DETAIL PLAN VIEW
NUDURA FOAM INSERT BILLET FOR
12" CONCRETE CORE FORM

REV. NO. 001 KS	DWG. NO. FIB-03
DATE: JUNE 2009	
DRAWN BY: K. STILL	SCALE: 3"=1'-0"



STANDARD 8" FORM UNIT

REV. NO. 002 TV	DWG NO. N-08-1
REV. DATE: 08/01/08	
DRAWN BY: J. NEILON	SCALE: 1"=1'-0"