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

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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 B
                            3 Pages, 1 Appendix

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1.0   INTRODUCTION

At the request of NUDURA Corporation, Exova was retained to re-calculate the theoretical thermal resistance value 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 change the 2.5 inch thick EPS foam density from 1.3 lb/ft^3 to 1.4 lb/ft^3 on the original "NUDURA^{TM} 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 wall system was assigned the following Exova Identification No.:

Client Wall-System Configuration	Exova Identification No.
NUDURA^{TM} Insulated Concrete Form Wall System".	10-06-M0083 B

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. 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: *Thermal Resistance calculations of NUDURA TM Insulated Concrete Form.* 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: λ=0.035 instead of 0.036 W/m.K.	Annex 1

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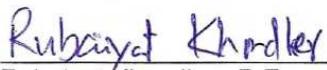
A summary of results is presented below in Table1. A detailed presentation of the values used in the total thermal resistance calculation is provided in Appendix B. In all cases, SI units are the primary units of measure.

Table 1 – Summary of Theoretical Thermal Transmission Values Exova Identification No.: 10-06-M0083 B			
Configuration	**Total Thermal Resistance**		
	R-value $°F.ft^2.h/Btu$	RSI-value m^2K/W	U-value W/m^2K
Outdoor Film (Winter Condition)	0.17	0.029	34.482
Siding (Hollow backed vinyl/steel)	0.61	0.107	9.345
Outer Insulation Panel	10.55	1.86	0.537
Concrete Core	0.58	0.102	9.804
Inner Insulation Panel	10.55	1.86	0.537
Gypsum Wallboard	0.45	0.080	12.5
Indoor Film	0.68	0.120	8.33
Total R-Value / RSI or U value	**23.59**	**4.158**	**0.2405**
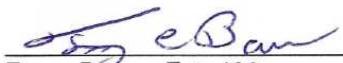
4.0   CONCLUSION

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
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Approved by:

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Manager, Building Performance Centre
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APPENDIX A

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

Thermal Resistance Calculations of NUDURA ^{TM} Insulated Concrete Form

(2 Pages)

September 21, 2004.

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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 ½-in. (12.5 mm) and depth of ¼-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/m^3) with a corresponding thermal resistivity of 4 °F ft^2·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 ft^2·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**
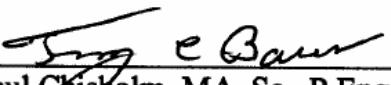
**Table 1 – Thermal resistance calculations for NUDURA™ wall system.**
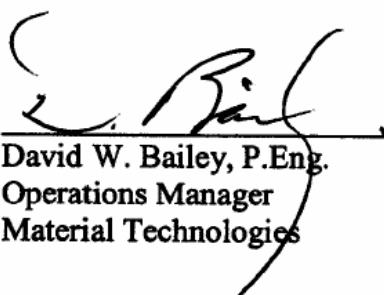
The total thermal resistance (R-value) of the assumed wall is 22.4 hr·ft^2·°F/Btu (3.94 m^2·K/W). The thermal transmittance (U-factor) is the inverse of the total R-value and is equal to 0.0447 Btu/hr·ft^2·°F (0.2538 W/m^{2}K).

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· ft^2· hr./Btu (0.185 m^2·K/W) thus increasing the overall resistance to 23.5 °F· ft^2· hr./Btu (4.125 m^2·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