



**HIGH-PERFORMANCE BUILDING  
CONSTRUCTION ASSEMBLIES  
AND DETAILS:  
THE IEA TASK 13 EXPERIENCE**

**Working Document of the International Energy Agency  
Task 13 of the Solar Heating and Cooling Program  
Final Report**

**PREPARED FOR:**

The CANMET Energy Technology Centre (CETC)  
Energy Technology Branch, Energy Sector  
Department of Natural Resources Canada  
Ottawa, Ontario, K1A 0E4  
Call-up No. 23440-93-9612  
November, 1996

**PREPARED BY:**

Enermodal Engineering Limited  
650 Riverbend Drive  
Kitchener, Ontario, N2K 3S2  
Tel: (519) 743-8777, Fax: (519) 743-8778  
Email: office@enermodal.com

**SCIENTIFIC AUTHORITY:**

Dr. Roger Henry  
The CANMET Energy Technology Centre (CETC)  
Energy Technology Branch, Energy Sector  
Department of Natural Resources Canada  
580 Booth Street  
Ottawa, Ontario, K1A 0E4

## CITATION

Enermodal Engineering Limited, *High-Performance Building Construction Assemblies and Details: The IEA Task 13 Experience*. Prepared under CANMET Call-up File No. 23440-93-9612. The CANMET Energy Technology Centre (CETC), Energy Technology Branch, Energy Sector, Department of Natural Resources Canada, Ottawa, Ontario, 1996 (63 pages).

Copies of this report may be obtained through the following:

The CANMET Energy Technology Centre (CETC)  
Energy Technology Branch, Energy Sector  
Department of Natural Resources Canada  
580 Booth Street, 13th Floor  
Ottawa, Ontario,  
K1A 0E4

or

Intellectual Property and Technical Information Management  
Library and Documentation Service Division, CANMET  
Department of Natural Resources Canada  
562 Booth Street  
Ottawa, Ontario  
K1A 0G1

## DISCLAIMER

This report is distributed for informational purposes only and does not necessarily reflect the views of the Government of Canada nor constitute an endorsement of any commercial product or person. Neither Canada nor its ministers, officers, employees or agents make any warranty in respect to this report or assumes any liability arising out of this report.

## NOTE

Funding for this project was provided by the Federal Panel on Energy Research and Development, Department of Natural resources Canada.

# **High-Performance Building Construction Assemblies And Details: The IEA Task 13 Experience**

## **Summary**

Task 13 of the International Energy Agency Solar Heating and Cooling Program involved designing, building and monitoring low-rise residential buildings with extremely low total purchased energy requirements. Envelopes were built with high levels of insulation, minimized thermal bridging, high-performance windows and air-tight design.

This report goes beyond the final report of the Task to document and quantify the energy-impact of the energy-efficient construction assemblies and details used in twelve of the buildings. This was done to encourage and facilitate implementation by the construction industry.

In general the building assembly u-values for the houses studied, wood frame, steel frame and masonry, were twice as good as for conventional housing. Windows too demonstrated exceptionally high efficiency. Weaknesses were window/wall interfaces and below grade wall/basement junctions.

Preparation of this report was undertaken as part of Canada's contribution to the Task 13 project.

## **Éléments fonctionnels et détails de la construction de bâtiments à haut rendement : l'expérience *Task 13* de l'AIE**

### **Résumé**

*Task 13*, un élément du Programme de chauffage et de climatisation par énergie solaire de l'Agence internationale de l'énergie, prévoit la conception, la construction et la surveillance de bâtiments résidentiels dont les exigences globales en énergie achetée sont minimales. Les enveloppes des bâtiments ont été conçues pour présenter des niveaux élevés d'isolation, des possibilités réduites de ponts thermiques, des fenêtres à haut rendement énergétique et des caractéristiques d'étanchéité à l'air.

Ce rapport s'ajoute au rapport définitif de *Task 13* puisqu'il vient étayer et quantifier les conséquences énergétiques des éléments fonctionnels et des détails de construction favorisant l'efficacité énergétique, tels que l'on retrouve dans douze bâtiments. En fait, le rapport vise à inciter et à favoriser la mise en application par l'industrie de la construction des techniques, des systèmes et des dispositifs utilisés.

En général, les coefficients de transmission de la chaleur dans les éléments fonctionnels de construction à l'intérieur des maisons étudiées, soit les charpentes en bois, les charpentes en acier et les bâtisses, s'avéraient deux fois meilleurs que dans le cas d'une maison classique. De même, les fenêtres ont présenté un rendement exceptionnel. Les seuls points faibles sont apparus à l'interface des fenêtres et des murs, ainsi qu'au raccordement des murs souterrains et des sous-sols.

On a entrepris la rédaction de ce rapport à titre de contribution du Canada à la réalisation du projet *Task 13*.

## **ACKNOWLEDGEMENTS**

This project was undertaken by IEA Task 13 to document the design and performance of the Task 13 houses. All Task 13 members assisted in collecting and reviewing the information. This report was written by Stephen Carpenter of Enermodal Engineering, Canada. The drawings were prepared by Heike Kluttig and Hans Erhorn of the Fraunhofer Institute for Building Physics, Germany. Guofeng Mao and Gudni Johanneson of KTH, Sweden performed the U-value calculations. Bart Poel of Damen Consultants, The Netherlands analysed the performance of the entire house.

## **TABLE OF CONTENTS**

	<i>Page</i>
ACKNOWLEDGEMENTS	iv
1.0 INTRODUCTION	1
1.1 Purpose	1
1.2 The Case for High-Performance Building Assemblies and Details	1
1.3 Evaluating the Thermal Performance of Building Assemblies and Details	2
2.0 CONVENTIONAL BUILDING ASSEMBLIES	5
2.1 Typical Wood Frame Construction	5
2.2 Typical Masonry (Brick) Construction	8
3.0 THE TASK 13 BUILDING ASSEMBLIES	11
3.1 BELGIUM - PLEIADE ROW HOUSE (LOUVAIN-LA-NEUVE)	12
3.2 CANADA - BRAMPTON ADVANCED HOUSE	15
3.3 CANADA - WATERLOO REGION GREEN HOME	18
3.4 DENMARK - KOLDING ROW HOUSE	21
3.5 FINLAND - IEA 5 HOUSE (PIETARSAARI)	24
3.6 GERMANY - ULTRAHOUSE (ROTTWEIL)	27
3.7 GERMANY - ZERO HEATING ENERGY HOUSE (BERLIN)	30
3.8 JAPAN - WISH HOUSE (IWAKI)	33
3.9 NETHERLANDS - URBAN VILLA (AMSTELVEEN)	36
3.10 NORWAY - IEA TASK 13 HOUSE (HAMAR)	39
3.11 SWEDEN - ROSKAR LOW ENERGY HOUSE	42
3.12 SWITZERLAND - DUPLEX IN GELTERKINDEN	45
4.0 COMPARISON OF BUILDING ASSEMBLIES	48
4.1 Wall Systems	48
4.2 Foundation Systems	49
4.3 Task 13 Roof Systems	50
4.4 Task 13 Window Systems	52

5.0	COMPARISON OF BUILDING DETAILS	54
5.1	Comparison of U-values	54
5.2	Impact of Details on House Performance	55
6.0	CONCLUSIONS	58
7.0	REFERENCES	59

## **LIST OF TABLES**

	<b>Page</b>
4.1 Task 13 Wall Systems	49
4.2 Task 13 Foundation Systems	51
4.3 Task 13 Roof Systems	52
4.4 Task 13 Window Systems	53
5.1 Linear U-values of the Construction Details (in W/mK)	55
5.2 Heat Balance for Rottweil and Typical Masonry Houses (in MJ)	57
5.3 Heat Balance for Waterloo and Typical Wood Frame Houses (in MJ)	57