SOLAR LOW ENERGY BUILDINGS AND THE INTEGRATED DESIGN PROCESS

An introduction

Task 23-Optimization of
Solar Energy Use in Large Buildings

INTERNATIONAL ENERGY AGENCY
Solar Heating & Cooling Programme

Acknowledgements

Author:

Nils Larsson
Canmet Energy Technology, Ottawa, Canada

Co-author:

Bart Poel
EBM-consult, Arnhem, The Netherlands

Design/Layout:

Marlies Rietveld
CEA, Rotterdam, The Netherlands

Ruud Vincent
Meneer Vincent, Rotterdam, The Netherlands

Cover:

Helmut Jahn
Hand sketches of the Headquarters of Deutsche Post in Bonn
Murphy/Jahn Architects – Chicago

Print:

Drukkerij Gebroeders Peters
Rotterdam, The Netherlands

Distribution through:

EBM-consult
P.O. Box 694, 6800 AR Arnhem, The Netherlands
e-mail: info@ebm-consult.nl

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1 Introduction

This booklet provides a short explanation of the characteristics of an Integrated Design Process (IDP) and its benefits and gives an overview of the results of Task 23, a project within the Solar Heating and Cooling (SHC) programme of the International Energy Agency. Task 23 "Optimization of Solar Energy Use in Large Buildings" has focused its work on exploring the nature of the IDP, an approach and design procedure that has proven to be highly effective in producing high-performance and environmentally-friendly buildings. Twelve countries were involved in this Task over a five-year period, putting together the expertise from researchers, architects and consultants in producing a practical approach towards IDP. The IDP approach has been applied in a number of real design processes, and the evaluation of this experience has provided valuable feedback.
The following countries participated in the task:

Austria	Germany	Spain
Canada	Japan	Sweden
Denmark	Norway	Switzerland
Finland	The Netherlands	USA

Before presenting detailed features of the integrated design process and of the products of the Task, it will be useful to provide a summary of the reasons why IDP is considered an important element of modern building design, especially in projects that require a high level of environmental performance. The essence of IDP is explained briefly followed by an overview of the methods and tools developed in the Task. Some experiences from practice are included.

On the IEA web site www.iea-shc.org/task23 the complete results of IEA SHC Task 23 are available and can be downloaded free of charge.

2 The Need for Better Performance

The global drive towards sustainable development has resulted in an increasing level of pressure on building developers and designers to produce buildings with a markedly higher level of environmental performance. Although various experts have somewhat different interpretations, a consensus view is that such buildings must achieve measurably high performance, over the full life-cycle, in the following areas:

- Minimal consumption of non-renewable resources, including land, water, materials and fossil fuels;
- Minimal atmospheric emissions related to global warming and acidification;
- Minimal liquid effluents and solid waste;
- Minimal negative impacts on site ecosystems;
- Maximum quality of indoor environment, in the areas of air quality, thermal regime, illumination and acoustics/noise.

Some authorities in this rapidly developing field would add related issues such as adaptability, flexibility and operating cost as well as life-cycle cost.

In addition to a new breadth of performance issues to be addressed, contemporary developers and designers are faced with more stringent performance requirements being imposed by markets or regulation, or both. Chief amongst these is energy performance, and this poses a definite challenge to designers, in terms of reducing purchased energy consumption and in the application of solar technologies, all within the constraints of minimal fees and the time pressure of the modern development process.

Community Centre Municipality of Kolding, Denmark

The Conventional Design process

Although there are many exceptions, we can refer to a "traditional" design process as consisting of the following features:

- The architect and the client agree on a design concept, consisting of a general massing scheme, orientation, fenestration and, usually, the general exterior appearance as determined by these characteristics as well as basic materials;
- The mechanical and electrical engineers are then asked to implement the design and to suggest appropriate systems.

Although this is vastly oversimplified, such a process is one that is followed by the large majority of general-purpose design firms, and it generally limits the performance levels achievable to conventional levels. The traditional design process has a mainly linear structure due to the successive contributions of the members of the design team. There is a limited possibility of optimisation during the traditional process, while optimisation in the later stages of the process is often troublesome or even impossible. The design and performance implications of such a process often include the following practical consequences:

- The building takes little advantage of the potential benefits offered by solar gain during the heating season, resulting in greater heating demand;
- The building may be exposed to high cooling loads during the summer, due to excessive glazing exposed to summer sun;
- The building may not be designed to take advantage of its daylighting potential, due to a lack of appropriately located or dimensioned glazing, or inappropriate glazing types, or a lack of features to bring the daylight further into the interior of the building;
- Occupants may be exposed to severe discomfort, due to excessive local overheating in West-facing spaces or glare in areas without adequate shading.

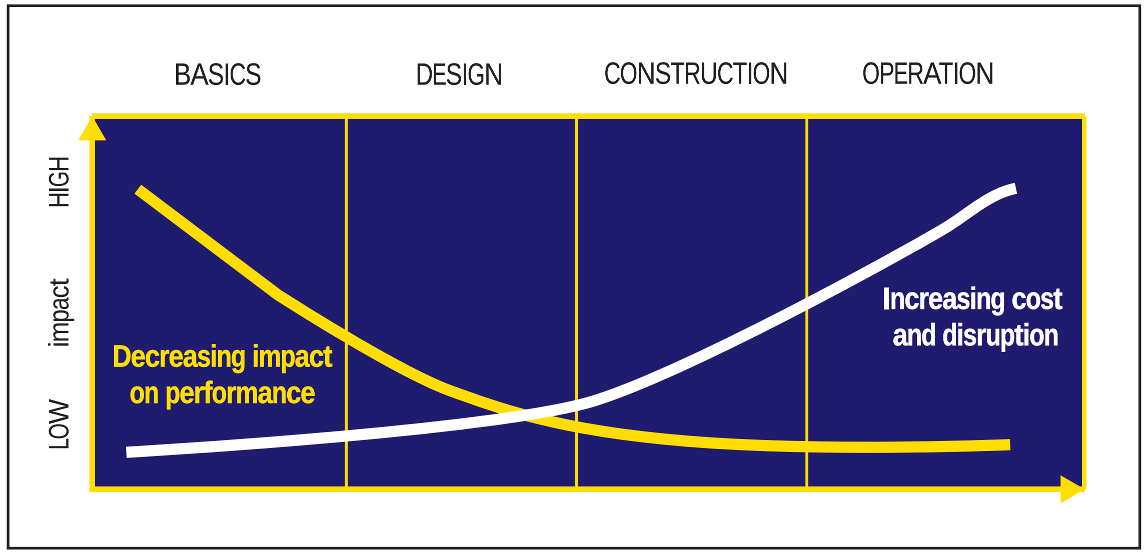
All these features are the result of a design process that appears to be quick and simple, but they result in high operating costs and create an interior environment that is sub-standard; and these factors in turn may greatly reduce the long-term rental or asset value of the property. Of course, since the conventional design process usually does not involve computer simulations of predicted energy performance, the resulting poor performance and high operating costs will come as a surprise to the owners, operators or users.

If the engineers involved in such a process are clever, they may suggest some very advanced and high-performance heating, cooling and lighting systems, but these may result in only marginal performance increases, combined with considerable capital cost increases. The underlying cause is that the introduction of high-performance systems late in the design process cannot overcome the handicaps imposed by the initial poor design decisions.
The problems outlined above represent only the most obvious deficiencies often found in buildings that result from the conventional design process. In summary, the conventional design process is not generally capable of delivering the high levels of broad-spectrum performance that are required in many contemporary projects.

3 The Integrated Design Process

The Integrated Design Process involves a different approach from the very early stages of design, and can result in a very different result. In the simplest of terms, the IDP process requires a high level of skills and communication within the team, involves a synergy of skills and knowledge throughout the process, uses modern simulation tools, and leads to a high level of synergy and integration of systems. All of this can allow buildings to reach a very high level of performance and reduced operating costs, at very little extra capital cost.

The IDP process is based on the well-proven observation that changes and improvements in the design process are relatively easy to make at the beginning of the process, but become increasingly difficult and disruptive as the process unfolds. Changes or improvements to a building design when foundations are being poured, or even contract documents are in the process of being prepared, are likely to be very costly, extremely disruptive to the process, and are also likely to results in only modest gains in performance. In fact, this observation is applicable to a large number of processes beyond the building sector.



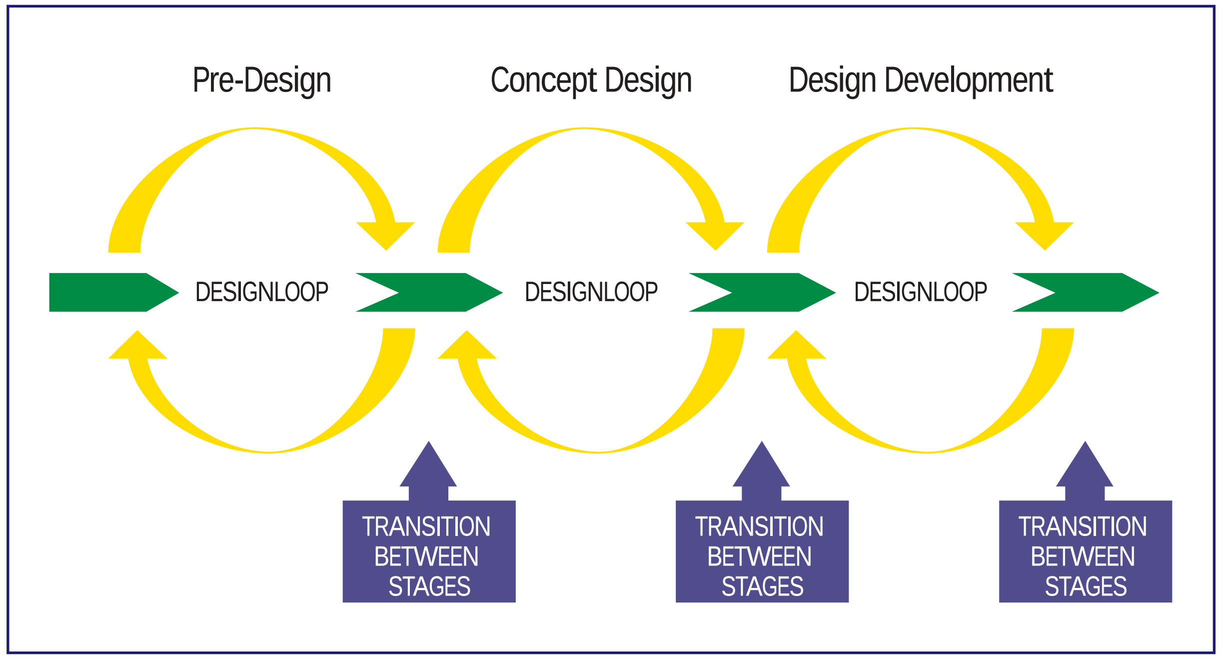
Solidar, Berlin Germany

Although these observations are hardly novel, it is a fact that most clients and designers have not followed up on their implications. The methods and tools developed in Task 23, and introduced in this booklet, represent the first international attempt to build on these facts and to develop a formalised process that will enable a large number of clients and designers to take advantage of them.

The IDP includes some typical elements that are related to integration:

- Inter-disciplinary work between architects, engineers, costing specialists, operations people and other relevant actors right from the beginning of the design process;
- Discussion of the relative importance of various performance issues and the establishment of a consensus on this matter between client and designers;
- Budget restrictions are applied at the whole-building level, and there is no strict separation of budgets for individual building systems, such as HVAC or the building structure. This reflects the experience that extra expenditures for one system, e.g. for sun shading devices, may reduce costs in other systems, e.g. capital and operating costs for a cooling system.
- The addition of a specialist in the field of energy, comfort or sustainability;
- The testing of various design assumptions through the use of energy simulations throughout the process, to provide relatively objective information on this key aspect of performance;
- The addition of subject specialists (e.g. for daylighting, thermal storage etc.) for short consultations with the design team;
- A clear articulation of performance targets and strategies, to be updated throughout the process by the design team.
- In some cases, a Design Facilitator may be added to the team, to raise performance issues throughout the process and to bring specialised knowledge to the table.

Based on experience in Europe and North America, the overall characteristic of an IDP is the fact that it consists of a series of design loops per stage of the design process, separated by transitions with decisions about milestones. In each of the design loops the design team members relevant for that stage are participating in the process.



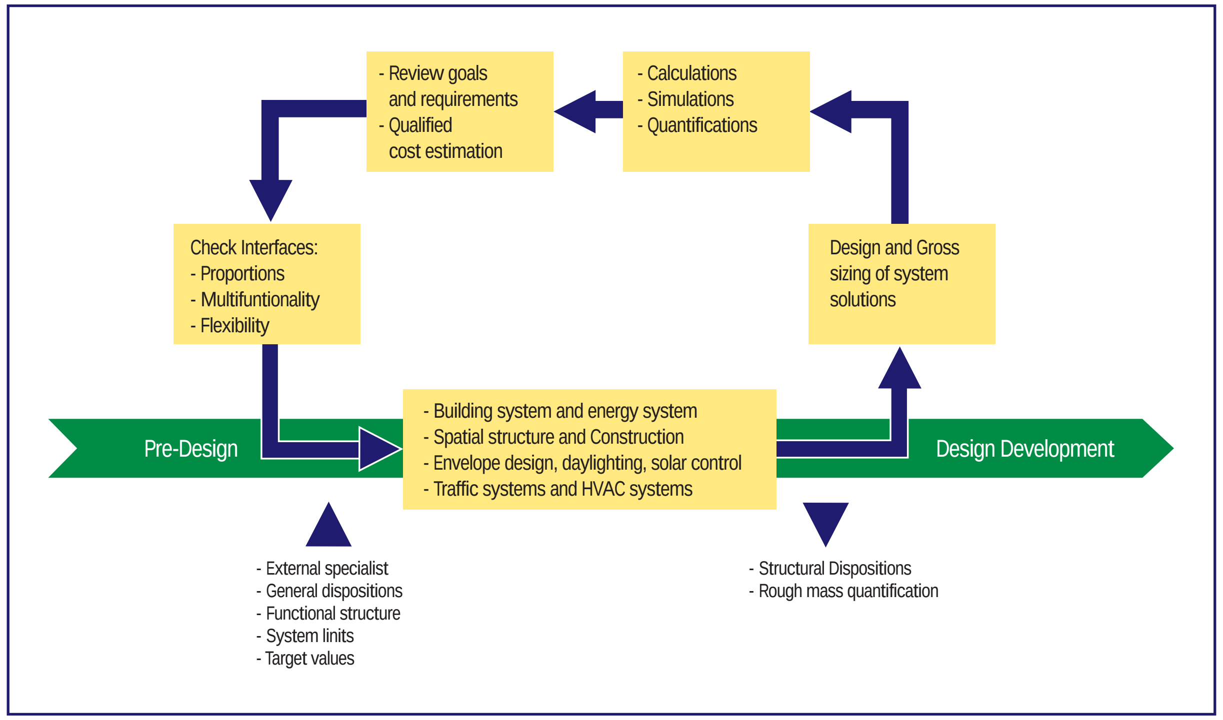
Solidar, Berlin Germany

The design process itself emphasises the following sequence:

- First establish performance targets for a broad range of parameters, and develop preliminary strategies to achieve these targets. This sounds obvious, but in the context of an integrated design team approach it can bring engineering skills and perspectives to bear at the concept design stage, thereby helping the owner and architect to avoid becoming committed to a sub-optimal design solution;
- Then minimise heating and cooling loads and maximise daylighting potential through orientation, building configuration, an efficient building envelope and careful consideration of amount, type and location of fenestration;
- Meet these loads through the maximum use of solar and other renewable technologies and the use of efficient HVAC systems, while maintaining performance targets for indoor air quality, thermal comfort, illumination levels and quality, and noise control;
- Iterate the process to produce at least two, and preferably three, concept design alternatives, using energy simulations as a test of progress, and then select the most promising of these for further development.

As an example a more detailed description of the design loop during the concept design phase is pictured. The central issue in this phase is to define systems in a conceptual way, based on the structure/scheme of the building. In a loop several options are considered, paying attention to the integration in the building as a whole, not just restricted to the technical aspects.

The Integrated Design Process in the Concept Design Phase



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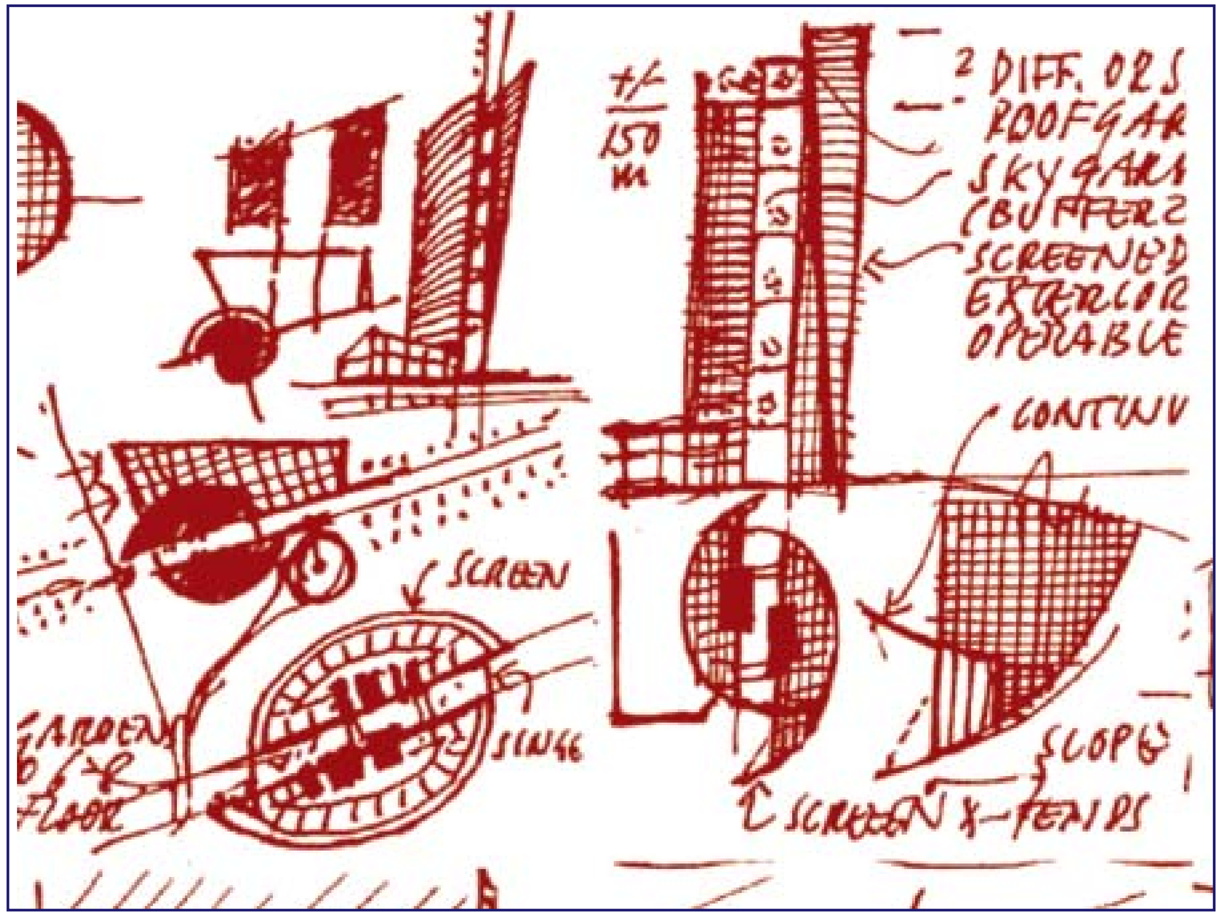
The IDP process contains no elements that are radically new, but integrates well-proven approaches into a systematic total process. From an engineering perspective, the skills and experience of mechanical and electrical engineers, and those of more specialised consultants, can be integrated at the concept design level from the very beginning of the design process. When carried out in a spirit of co-operation amongst key actors, this results in a design that is highly efficient with minimal, and sometimes zero, incremental capital costs, along with reduced long-term operating and maintenance costs. The benefits of the IDP process are not limited to the improvement of environmental performance. The experience of Task 23 members is that the open inter-disciplinary discussion and synergistic approach will often lead to improvements in the functional program, in the selection of structural systems and in architectural expression.



Sketches by Helmut Jahn (Murphy/Jahn Architects – Chicago)

The Integrated Design Process has impacts on the design team that differentiates it from a conventional design process in several respects. The client takes a more active role than usual; the architect becomes a team leader rather than the sole form-giver, and the mechanical and electrical engineers take on active roles at early design stages. The team always includes an energy specialist, and in some cases, an independent Design Facilitator.

4 Methods and Tools to Support IDP

Task 23 has produced guidelines, methods and tools to help designers to implement the IDP process: The complete list of Task 23 deliveries is given in appendix B.

- **An Introductory Booklet,** (this report) providing a short explanation of the characteristics of an Integrated Design Process an introducing the results of Task 23,

- **The IDP Guideline,** is a comprehensive description of the philosophy, rationale and features of the IDP process, and of the companion IDP Navigator. The Guideline provides interactive access to background information, including key issues and recommendations in a checklist format.

- **The IDP Navigator;** an information source containing important process related and technical issues that are crucial for IDP, produced as a software package. Users can navigate through the information using an interface that is structured according to the steps in the design process. It provides detailed support to users in identifying the elements and inter-relations between steps in the Integrated Design Process. The structure and contents of the Navigator are consistent with the IDP Guideline, but the knowledge base can be modified according to the needs of a specific user.
  A user manual and presentations on how to use the IDP Navigator are also available.

- **Examples of Integrated Design;** a Case Story booklet that characterises the design process used in a number of high-performance projects. These projects formed part of the background information used by Task 23 members to develop IDP methods and tools.

  Description of Case Stories; produced as a Technical Report with more detailed information about the case stories that were part of the survey.
  This extensive description was the basis for the case stories booklet.

- **The Integrated Design Process in Practice;** a collection of Demonstration Projects providing examples of design processes in which some of the Task 23 methods and tools have been used to support the design process.

- **A Blueprint for a Kick-off Workshop** as a basis for the organisation of a design team workshop right at the beginning of the IDP. The main objective of the workshop is to create common understanding at the beginning of the design process.
  The blueprint is a separate part of the IDP Guideline mentioned above.

- **The MCDM-23,** a Multi Criteria Decision Making method with an accompanying software tool; intended for use both in normal building design processes and in competitions. The name reflects the fact that the evaluation of several alternatives is a multi-criteria decision making process. The method assists the team in the selection of and in the prioritisation of design criteria, and in the evaluation of alternative design solutions. In design competitions, the method can assist in developing the program and to select the best design amongst several alternatives.
  The MCDM-23 software tool automates many of the tasks involved in using the method, and also produces worksheets, bar charts and star diagrams.
  A user manual and a booklet on how to use the MCDM 23 together with a MS-PowerPoint presentation are also available.

- **Energy 10;** a user-friendly energy simulation system that provides predictions of operating energy performance and identifies the most effective design strategies in reaching this performance level. Energy 10 is being continuously improved and now offers users an economical and highly effective simulation process for early design support.

All of these Task 23 products are downloadable from the IEA SHC Task 23 web-site (www.iea-shc.org/task23) except for Energy 10.

The following diagram provides suggestions for the most useful points of intervention for the Task 23 methods and tools.
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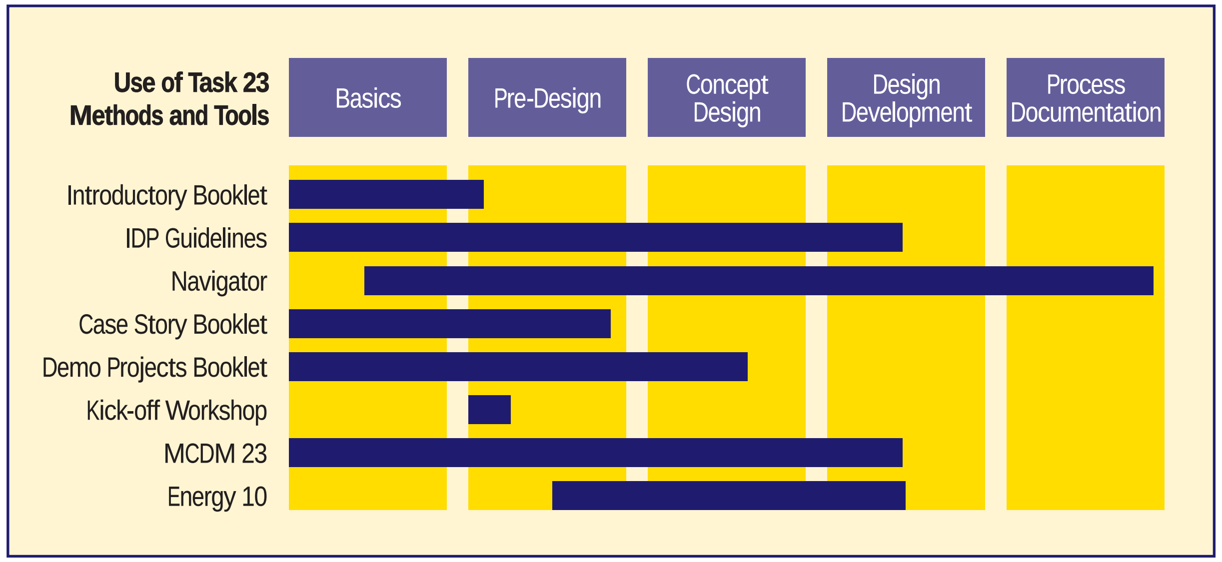

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5 Evidence of success in practice

The need for methods and tools to be developed by Task 23 was defined on the bases of experiences in a number of projects characterised by a type of design process that was meant to facilitate integration. In the booklet "Examples of Integrated Design" five cases are described.

One of them is the **Bentall Crestwood 8 Building** in Richmond (British Columbia; Canada).
Two office buildings were realised, alike in look and with comparable building cost. Yet one of them is about 30% more energy efficient than the other and the amount of waste during construction was reduced by 50%. Compared to conventional buildings the energy consumption was even reduced with 50%. The building met the strict sustainability requirements from the C-2000 programme. In order to achieve these results an interdisciplinary design team worked together right from the beginning of the design process. A design process facilitator supported the design team. This approach proved to be very successful.

Architect:
Bunting Coady Architects, Vancouver

HVAC/engineers:
VEL engineering Vancouver

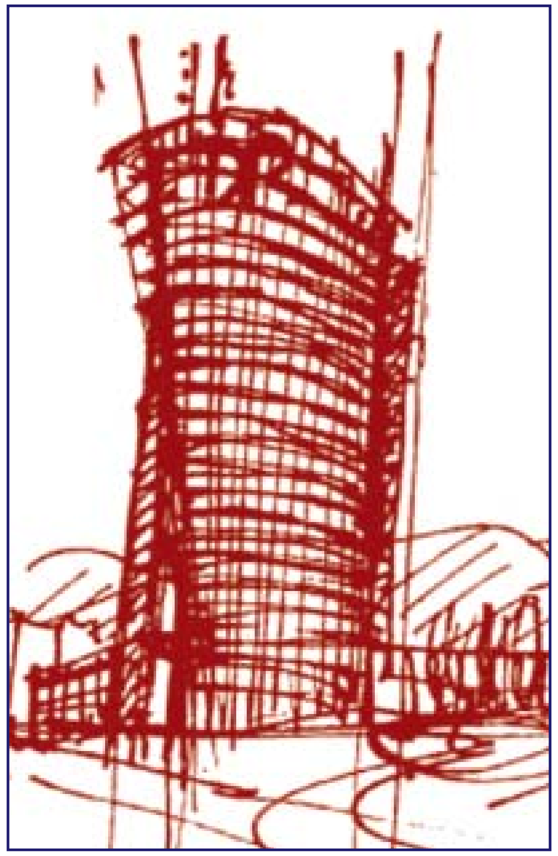
Engineers Energy/comfort:
D.W. Thomson Consulting ltd.
Vancouver

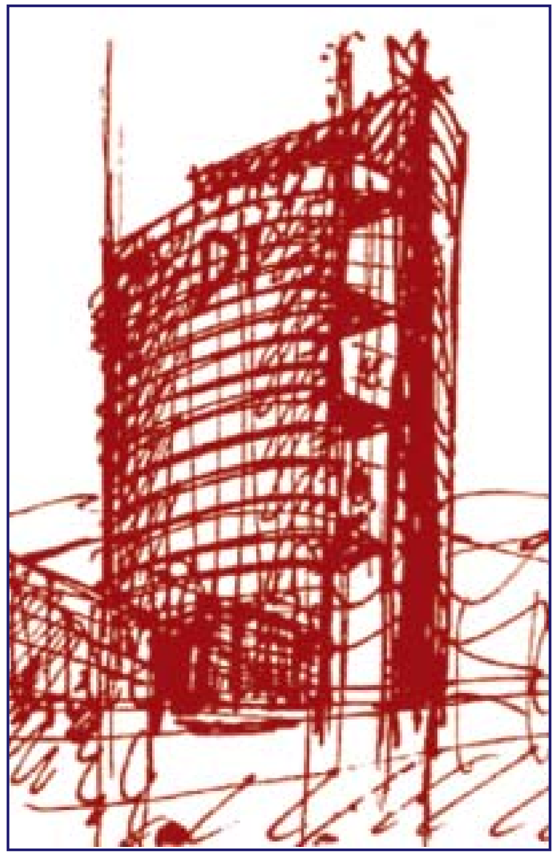
Facilitator:
Cannet Energy Technology Centre
Ottawa

Photo by Bunting Coady Architects - Vancouver

As outlined above, guidelines, methods and software tools were developed during Task 23.
Towards the end of the project, some of these support tools were applied in demonstration projects with the focus on the Integrated Design Process. Five demonstration projects are evaluated in the booklet "The Integrated Design Process in Practice". They illustrated the benefits of IDP together and give insight in some of the key factors to enable IDP.

One of the most prestigious projects is the **Headquarters of the Deutsche Post AG.** A forty-three story building in the city of Bonn Germany. The client required a supportive working environment, individual control and operable windows in this high rise building. The architect and the key actors of the design team had successful previous experience with IDP. A Kick-off workshop right at the beginning of the competition created a very effective start of the process. The building is provided with an innovative ventilation and comfort concept, integrated in the total design of the building.





Architect:
Murphy/Jahn, Chicago, USA

HVAC/electrical engineers:
Brandi Consult, Köln-Berlin

Engineers Energy/comfort:
Transolar Energytechnik, Stuttgart

Structural engineers:
Werner Sobek, Ingenieure Stuttgart

Project manager:
Anderson Consulting, Frankfurt

The client and the project manager had to be convinced about the necessity of the intensive exchange in the early stages of the design process. As a result of the IDP a final concept with the integration of the ventilation and comfort concept in the building form was developed. Through IDP it was possible to make a clear decision about the level of building performance related to higher investments and energy savings.
Finally, the client is satisfied with the process and the building performance, and the team has learned about the potentials of IDP.

Photograph by Anja Thierfelder - Stuttgart

In Denmark a **Community Centre** was planned by the Municipality of Kolding. The objective was to create an overall solution for future buildings for all age groups and social stratums. Furthermore, the goal was to optimise the building in terms of resource use, functionality and ecology. An IDP was considered the most appropriate approach. In the competition phase a brainstorm workshop was organised among the architects and engineers in order to discuss and evaluate specific topics of integration. During the design process the MCDM 23 tool was used to help identify the objectives, sort out poor solutions and to document the design. Passive and active solar energy techniques are applied in the building, together with other sustainable features.

Photograph by Municipality of Kolding

Architect:
White Architects A/S
Copenhagen

HVAC/energy/comfort/electrical engineers:
Esbensen consulting Engineers A/S
Copenhagen

Structural engineers:
Sloth Moller Consulting Engineers A/S

Project manager:
Kolding Municipality

Main contractor:
NCC Denmark A/S

The efficiency of the process was a positive outcome of the IDP. The client considered that the resulting good indoor climate and reduced energy operating cost were a direct result of using the IDP process. The client is very satisfied and the team members intend to use IDP in future projects.

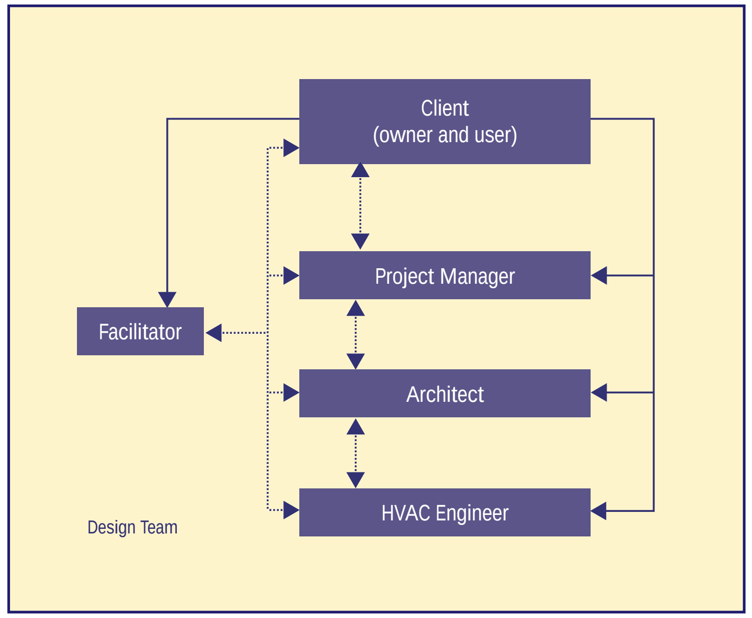
The **Rabobank building** in Zierikzee, the Netherlands was required in order to centralise the local activities of the bank in one new building. This building had to be sustainable and comfortable, within the financial targets (pay back time on energy measures of seven years). The argument for choosing an IDP was to create a more optimal and efficient building at no extra building cost. All members of the design team were contracted for a standard fee, only a facilitator added to the team was paid for by a governmental funding agency (NOVEM).

Architect:
Archikon bv
Goes

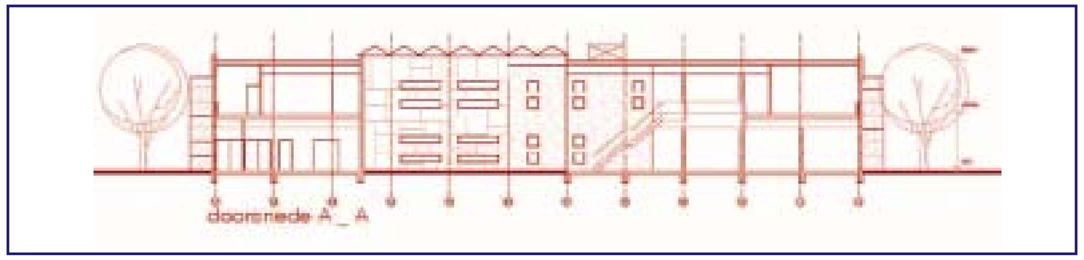
HVAC/energy/comfort engineers:
Huisman & van Muijen
's Hertogenbosch

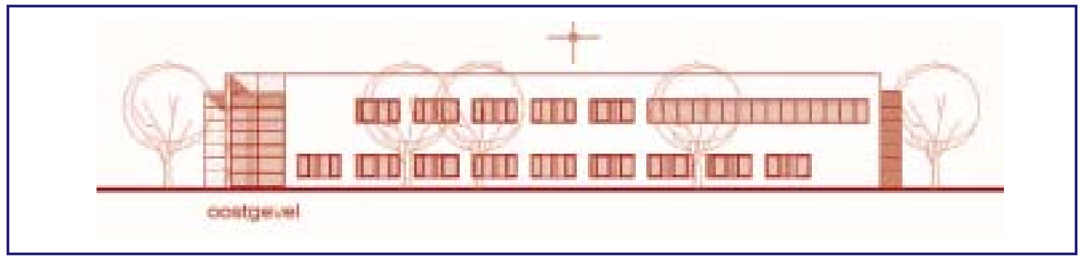
Project management:
Rabobank Nederland Capabel
Rijen

Facilitator:
EBM-consult
Arnhem



A Kick-off workshop provided a common understanding of the design task among all the team members. The MCDM 23 tool was used to evaluate and discuss design options with the program of requirements as a reference. Energy 10 turned out to be a very helpful energy calculation method during the design process. There was special focus on minimising the HVAC-system by an adequately designed building envelope in relation to the architecture. This resulted in a design with an estimated reduction of energy consumption of about 30%. The members of the team as well as the client were positive about the IDP approach.





Drawings by Archikon bv - Goes

The **overall experience** from the different projects is positive. The tools are an important support when they are applied in a way that fits the specific design context (e.g. national or local default values in MCDM 23 and Energy 10).
The projects in general demonstrated the benefits of an Integrated Design Process: a high level of performance and reduced operating costs, at very little extra capital cost.

6 Impact of IDP on design

Task 23 has shown that there are significant advantages related to an Integrated Design Process (IDP).

Integration on the level of the process results in synergies at both the systems level and the whole-building level, as the following examples demonstrate:

- Early discussion of the functional program and project goals with the client, architect and engineers may identify anomalies and ambiguities, and rapid clarification of this will lead to subsequent improvements in the functionality of the building;
- Careful orientation, massing, fenestration and the design of shading devices can reduce heating and cooling loads, and will often improve thermal comfort;
- A high-performance building envelope will greatly reduce unwanted heat losses or gains, often to the point where heating or cooling systems are not required to operate at the perimeter of the building, resulting in capital cost savings and a gain in usable space;
- An emphasis on daylighting will reduce cooling loads, because of reduced lighting requirements, and may also improve illumination quality;
- These factors will permit a reduction in floor-to-floor heights (or improved daylighting because of higher net floor height), and will also permit a reduction in HVAC plant and system capacity and size requirements. Significant load reductions also open the way for use of alternative and simpler systems, such as radiant heating and cooling and natural or hybrid ventilation;
- Reductions in boiler, chiller, AHU and ducting sizes will, in turn, reduce capital, operating, maintenance and replacement costs;
- A deeper understanding of the nature and inter-relationships of all the issues described above, will lead to the possibility of a higher level of architectural expression.

The overall conclusion is that the Integrated Design process has been shown in many case studies to result in high levels of performance, a superior indoor environment and greatly reduced operating costs, at little extra capital cost. In order to achieve an integrated building in terms of performance and cost, a traditional design process is in many cases ineffective. Although there will always be individual designers who are able to design brilliant buildings in an individualistic way, the IDP approach will be of significant benefit to most designers and clients who are attempting to achieve excellence in building design.

APPENDIX A

List of Task 23 results

BOOKLETS (available through web site)

Solar Low Energy Buildings and the Integrated Design Process
An Introduction

Nils Larsson	Canmet Energy Technology, Ottawa, Canada
Bart Poel	EBM-consult, Arnhem, The Netherlands

Multi-Criteria Decision-Making MCDM-23
A method for specifying and prioritising criteria and goals in design

Douglas Balcomb	National Renewable Energy Laboratory Golden CO, USA
Inger Andresen	SINTEF Civil and Environmental Engineering Trondheim, Norway
Anne Grete Hestnes	NTNU Trondheim, Norway
Søren Aggerholm	Danish Building and Urban Research Hørsholm, Denmark

MCDM-23 User Manual

Douglas Balcomb	National Renewable Energy Laboratory

Examples of Integrated Design

Gerelle van Cruchten	EBM-consult, Arnhem, The Netherlands
Susanne Geissler	Austrian Ecology Institute, Vienna, Austria
Nils Larsson	Canmet Energy Technology, Ottawa, Canada
Christina Henriksen	Esbensen Consulting Engineers, Copenhagen, Denmark
Matthias Schuler	Transsolar, Stuttgart, Germany
Douglas Balcomb	National Renewable Energy Laboratory Golden CO, USA

The Integrated Design Process in Practice
Demonstration Projects Evaluated

Bart Poel	EBM-consult
Gerelle van Cruchten	Arnhem, The Netherlands
Ger de Vries	
Els Sonnemans	
Eric Bouten	
Nils Larsson	Canmet Energy Technology, Ottawa, Canada
Torben Esbensen	Esbensen Consulting Engineers, Copenhagen, Denmark
Matthias Schuler	Transsolar, Stuttgart, Germany, Golden CO, USA

SOFTWARE (available through web site)

Integrated Design Process
A guideline for sustainable an Solar-Optimised Building Design

Günther Löhnert	Solidar Architects and Engineers
Andreas Dalkowski	Berlin, Germany
Werner Sutter	Architekten B+S, Zug, Switzerland

Navigator

Pierre Jaboyedoff	Sorana SA
Michel Jaboyedoff	Lausanne, Switzerland
Günther Löhnert	Solidar Architects and Engineers
Andreas Dalkowski	Berlin, Germany
Werner Sutter	Architekten B+S, Zug, Switzerland

MCDM-23 Software

Jun Tanimoto	Kyushu University
Parichart Chomklai	Fukuoka, Japan

TECHNICAL REPORT

Description of case Stories (Technical report)

Christina Henriksen	Esbensen Consulting Engineers, Copenhagen, Denmark

About Energy 10.

The software programme Energy 10 was used in Task 23. It is not a developed within the Task but can be of great use during the design process. Information about Energy 10 is available through the Sustainable Buildings Industry Council (SBIC) Washington DC, USA.

Web-site: **www.sbicouncil.org/enTen**

APPENDIX B
IEA-SHC Task 23

Introduction

To significantly reduce the total energy use in large buildings, it is necessary to use several systems and technologies, such as energy conservation, daylighting, passive solar, active solar, and photovoltaics, in combination. The designers of these buildings therefore need to find the optimum combinations of technologies for each specific case. This requires an integrated design approach, where the different low energy and solar technologies to be used are considered integral parts of the whole.

Task 23 of the International Energy Agency's Solar Heating and Cooling Programme has enabled the designers to realize such integrated design processes and to carry out the necessary optimisation exercises, thereby ensuring the most appropriate use of solar energy in each building project. This has been done by providing the designers with a set of design tools. At the same time, the Task has ensured that the buildings designed using these tools promote sustainable development. This has been done by including criteria such as general resource use and local and global environmental impact in the analyses facilitated.

The work in the Task focused primarily on commercial and institutional buildings, as these types of buildings all need more than one type of system. In particular, office buildings and educational buildings were addressed. The primary results of the work are guidelines, methods, and tools for use by building designers in the early stages of design. The Task also included demonstration buildings, as such buildings both provide an opportunity to test the design tools developed, and as they provide an effective way of demonstrating the integration of solar technologies in real buildings.

("Programme of Work" by Anne Grete Hestnes, April 1997)

Subtasks

The work in the Task is divided in four Subtasks:

Subtask A – Case Stories

(Subtask Lead Country: Denmark)

The objective of Subtask A was to provide the knowledge needed for guidelines, methods and tools, which were to be developed in other subtasks. This was done by evaluating and documenting a set of buildings designed using the "whole building approach". Both the processes used in the design of the buildings and the resulting performances were evaluated. The results of these studies have been documented in the report "Description of Case Stories" and in the booklet "Examples of Integrated Design"

Subtask B – Design Process Guidelines

(Subtask Lead Country: Switzerland)

The main objective of Subtask B was to develop design process guidelines suitable for the early stages of design, as the integrated design process approach is particularly important in these stages.

The guidelines will both deal with the make up of and the interaction between members of the design team, with the information required by the team, and with the ways of designing the building as a system, where the different low energy and solar technologies to be used are integral parts of the whole.

The main results of Subtask B are the "Integrated Design Process Guide" and the "Navigator".

Subtask C – Methods and Tools

(Subtask Lead Country: USA)

The main objective of Subtask C was to develop methods and tools to be used by the designers when doing trade-off analyses between different low energy and solar technologies. As designers, builders and owners optimise against a large number of criteria, such as energy use, comfort, cost, aesthetics, environmental impact, etc., a multi criteria decision making method was developed. The method is accompanied by a computer tool. The application of an energy calculation method that can be used from the very early stages of design is also recommended. Though the energy calculation tool Energy 10 is not developed within the Task, it does fit the objective quite well.

Therefore, national parameter sets were defined which makes this tool applicable for a wider audience.

The main results of Subtask C are the MCDM-23 method and MCDM-23 tool and twelve National Parameter Sets for Energy 10.

Subtask D – Dissemination and Demonstration

(Subtask Lead Country: The Netherlands)

The main objective of Subtask D was to disseminate the results of the work of the Task to the building community. Dissemination took place by setting up a web site, through which methods, tools and publications are available. Also highly energy efficient demonstration buildings have been developed by putting the integrated design process into practice. This resulted in a booklet: "The Integrated Design Process in Practice".

National Contact Persons for Task 23

Operating agent
Anne Grete Hestnes
Faculty of Architecture, NTNU
N-7491 Trondheim
annegrete.hestnes@ark.ntnu.no

Austria
Susanne Geissler
Osterreichisches Okologie-Institut
Seidengasse 13
A-1070 Vienna
geissler@ecology.at

Canada
Nils Larsson
Canmet Energy Technology Centre
13/F, 580 Booth St.
Ottawa, KIA 0E4
larsson@greenbuilding.ca

Denmark
Torben Esbensen
Esbensen Consulting Engs.
Mollegade 54-56
DK-6400 Sonderborg
torben@esbensen.dk

Finland
Jyri Nieminen
VTT, Building Technology
P.O. Box 1804
FIN-02044 VTT
jyri.nieminen@vtt.fi

Germany
Mathias Schuler
TRANSSOLAR
Curiestrasse 2
D-70563 Stuttgart
schuler@transsolar.com

Japan
Mitsuhiro Udagawa
Dept. of Architecture Kogakuin University
1-24-2 Nishi-Shinjuku-ku
Tokyo 163-8677
udagawa@cc.kogakuin.ac.jp

The Netherlands
Bart Poel
EBM-consult
P.O. Box 694
NL-6800 AR Arnhem
bpoel@ebm-consult.nl

Norway
Inger Andresen
SINTEF Civil and Environmental Engineering
N-7465 Trondheim
inger.andresen@sintef.no

Spain
Louis Alvarez
A.U.I.A.
c/Papa Negro 41B
Parque Conde de Orgaz
E-28043 Madrid
auia@telefonica.net

Sweden
Maria Wall
Dept. of Energy and Building Design, Lund University
P.O. Box 118
SE-221 00 Lund
maria.wall@ebd.lth.se

Switzerland
Pierre Jaboyedoff
SORANE SA
Route de CHâtelard 52
CH-1018 Lausanne
pierre.jaboyedoff@sorane.ch

USA
Douglas Balcomb
National Renewable Energy Lab.
1617 Cole Boulevard
Golden, CO 80401
doug_balcomb@nrel.gov

APPENDIX C

IEA Solar Heating and Cooling Programme

The International Energy Agency (IEA) was established in 1974 as an autonomous agency within the framework of the Economic Co-operation and Development (OECD) to carry out a comprehensive program of energy co-operation among its 25 member countries and the Commission of the European Communities.

An important part of the Agency's program involves collaboration in the research, development and demonstration of new energy technologies to reduce excessive reliance on imported oil, increase long-term energy security and reduce greenhouse gas emissions. The IEA's R&D activities are headed by the Committee on Energy Research and Technology (CERT) and supported by a small Secretariat staff, headquartered in Paris. In addition, three Working Parties are charged with monitoring the various collaborative energy agreements, identifying new areas for co-operation and advising the CERT on policy matters.

Collaborative programs in the various energy technology areas are conducted under Implementing Agreements, which are signed by contracting parties (government agencies or entities designated by them). There are currently 40 Implementing Agreements covering fossil fuel technologies, renewable energy technologies, efficient energy end-use technologies, nuclear fusion science and technology, and energy technology information centers.

The Solar Heating and Cooling Programme was one of the first IEA Implementing Agreements to be established. Since 1977, its 21 members have been collaborating to advance active solar, passive solar and photovoltaic technologies and their application in buildings.

Australia	Finland	Norway
Austria	France	Portugal
Belgium	Italy	Spain
Canada	Japan	Sweden
Denmark	Mexico	Switzerland
European Commission	Netherlands	United Kingdom
Germany	New Zealand	United States

A total of 30 Tasks have been initiated, 20 of which have been completed. Each Task is managed by an Operating Agent from one of the participating countries. Overall control of the program rests with an Executive Committee comprised of one representative from each contracting party to the Implementing Agreement. In addition, a number of special ad hoc activities—working groups, conferences and workshops—have been organised.

The Tasks of the IEA Solar Heating and Cooling Programme, both completed and current, are as follows:

Completed Tasks:

Task	**1**	Investigation of the Performance of Solar Heating and Cooling Systems
Task	**2**	Coordination of Solar Heating and Cooling R&D
Task	**3**	Performance Testing of Solar Collectors
Task	**4**	Development of an Insolation Handbook and Instrument Package
Task	**5**	Use of Existing Meteorological Information for Solar Energy Application
Task	**6**	Performance of Solar Systems Using Evacuated Collectors
Task	**7**	Central Solar Heating Plants with Seasonal Storage
Task	**8**	Passive and Hybrid Solar Low Energy Buildings
Task	**9**	Solar Radiation and Pyranometry Studies
Task	**10**	Solar Materials R&D
Task	**11**	Passive and Hybrid Solar Commercial Buildings
Task	**12**	Building Energy Analysis and Design Tools for Solar Applications
Task	**13**	Advance Solar Low Energy Buildings
Task	**14**	Advance Active Solar Energy Systems
Task	**16**	Photovoltaics in Buildings
Task	**17**	Measuring and Modeling Spectral Radiation
Task	**18**	Advanced Glazing and Associated Materials for Solar and Building Applications
Task	**19**	Solar Air Systems
Task	**20**	Solar Energy in Building Renovation
Task	**21**	Daylight in Buildings

Completed Working Groups:

CSHPSS

ISOLDE

Materials in Solar Thermal Collectors

Evaluation of Task 13 Houses

Current Tasks:

Task	**22**	Building Energy Analysis Tools
Task	**23**	Optimization of Solar Energy Use in Large Buildings
Task	**24**	Solar Procurement
Task	**25**	Solar Assisted Air Conditioning of Buildings
Task	**26**	Solar Combisystems
Task	**27**	Performance of Solar Facade Components
Task	**28**	Sustainable Solar Housing
Task	**29**	Solar Crop Drying
Task	**31**	Daylighting Buildings in the 21st Century

Current Working Groups:

PV/Thermal Systems

To receive a publications catalogue or learn more about the IEA Solar Heating and Cooling Programme visit our Internet site at http://www.iea-shc.org or contact the SHC Executive Secretary, Pamela Murphy, Morse Associates Inc., 1808 Corcoran Street, NW, Washington, DC 20009, USA, Tel: +1/202/483-2393, Fax: +1/202/265-2248, E-mail: pmurphy@MorseAssociatesInc.com.

INTERNATIONAL ENERGY AGENCY
Solar Heating & Cooling Programme