FINAL TECHNICAL REPORT – PUBLIC PART

Final draft, submitted to the European Commission for approval

CONTRACT N° : NNE5-2000-122

PROJECT N° :

ACRONYM : **WinDat**

TITLE : **European Thematic Network WinDat,
Windows as Renewable Energy Sources for Europe -
Window Energy Data Network**

PROJECT CO-ORDINATOR :
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PARTNERS :

Netherlands Organisation for Applied Scientific Research TNO a) TNO Building and Construction Research b) TNO Institute of Applied Physics National and Kapodestrian University of Athens Technical University of Denmark Fraunhofer-Institut für Solare Energiesysteme Swiss Federal Laboratories for Materials Testing and Research National University of Ireland, Dublin Oxford Brookes University Glaverbel Saint-Gobain Glass Deutschland Interpane Entwicklungs- und Beratungs-gesellschaft VELUX A/S PERMASTEELISA Hunter Douglas Europe B.V. Verosol Fabrics B.V. Belgian Building Research Institute VEROZO Esbensen Raadgivende Ingenioerer Danish Technological Institute	Fraunhofer-Institut für Bauphysik Asociación de Investigación y Cooperación Industrial de Andalucía Universidad de Cádiz Centre Scientifique et Technique du Bâtimenta) The Materials Departmentb) The Lightweight Construction and Transfer Department Centre National de la Recherche Scientifique (ENTPE) Italian Agency for the New Technologies, Energy and the Environment Stazione Sperimentale del Vetro Istituto Elettrotecnico Nazionale Galileo Feraris Istituto Nazionale di Architettura Technical Research Centre of Finland SP Swedish National Testing and Research Institute Uppsala University Building Research Establishment Ltd University of Strathclyde NPL Management Ltd Aluminium Center Belgium Unione Nazionale Costruttori Serramenti Alluminio Acciaio e Leghe

REPORTING PERIOD : FROM June 1, 2001 TO May 31, 2004

PROJECT START DATE : June 1, 2001 **DURATION : 36 months**

Date of issue of this report : July 31, 2004

There exist two different guidelines for reporting:
<da_rg_ecosystem_en_200001.doc>, obtained from
http://www.cordis.lu/eesd/manage.htm
This format is for among others: T.N.'s under the EESD Programme ➔ for WinDat?! Used here!
<da_rg_en_200001.doc>, obtained from
http://www.cordis.lu/eesd/
This format was said to be used for MTR and PR's, but is from DG Research

Project funded by the European Community under the 'Energy, Environment and Sustainable Development' Programme (1998-2002)

Windows as Renewable Energy Sources for Europe
Window Energy Data Network

Project supported by DG for Energy and Transport of the European Commission

www.windat.org

Front page in normally used format (from DG Research??)

contract NNE5-2000-122

Final Technical Report - Public Part

Final draft, submitted to the European Commission for approval

June 1, 2001 – May 31, 2004

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WinDat document N1.01 - Public **July 2004**

This document was produced within WinDat, with active contribution by the members of this European Thematic Network. See www.windat.org for more information.

Contact:

On this report or on Thematic Network WinDat in general:

WinDat coordinator: Dick van Dijk, TNO Building and Construction Research, Delft, The Netherlands
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Research funded in part by
THE EUROPEAN COMMISSION
in the framework of the Community activities
in the Field of the specific programme for RTD and demonstration on Energy, Environment and Sustainable Development

Table of contents

Extracted from the Guidelines:
These reports are not only an administrative or contractual requisite, but are real management, communication and working tools for all partners involved in a project. Therefore the documents should be clear, concise, meaningful and comprehensive.

> ***Deliverable reports***
>
> *In the Description of Work of most projects, other project specific reports are also indicated as deliverables (for instance at the end of a task). After completion of these deliverable reports, you should send one copy to the Project Officer in charge of your project. These deliverables can be sent attached to a periodic report or independently when the task is completed, as decided after discussion with the Project Officer.*

In addition to the Final Technical Report:
*"**Technological Implementation Plan**" : to provide a clear and focused description of the results and their actual and potential uses, in order to be a support for :*

- *the use and exploitation of results and the monitoring of this use, and*
- *the dissemination of the results in order to ensure maximum benefit for the European Union.*

More information in Guidelines for reporting (and see draft TIP, submitted along with Mid Term report

All reports and cost statements must be sent to the Project Officer:
For the attention of Mr./Mrs. XYZ (Office address + number) - European Commission, DG RTD/…, 200, rue de la Loi - B - 1049 Bruxelles, e-mail: XYZ@cec.eu.int.

Oral information Technical Officer DG TREN:

Final Technical Report: *4 copies*

(Other) deliverables: *2 copies*

Deadline: *July 31, 2004*

1. Part 1: Publishable Final Report (non-confidential)

1.1 Executive publishable summary

A summary page (non confidential) in a form suitable for publication should give the most significant aspects which describe the project : objectives, clear description of the results, their usefulness and possible applications and indications on the plans for use. This page will be used to update your current record in CORDIS.

Contract n°	NNE5-2000-122	Reporting period:	June 1, 2001 – May 31, 2004
Title	WinDat, Windows as Renewable Energy Sources for Europe _ Window Energy Data Network		

Objectives: The aim of the WinDat Thematic Network (June 2001 - May 2004) is to make available and widely distribute a free, European software tool with high quality input and output for the calculation of the thermal and solar properties of commercial and innovative window systems on the basis of known component (glazings, shading devices, frames and edges, gases,..) properties and thermal and solar/optical interactions between the components. Both for standard product information (based on routines from European standards) and for more advanced calculations (design conditions) and for innovative products for which no European standards exist yet. A tool that is collectively supported and used in research, industry, standardisation, education and design throughout Europe to compare, select and promote innovative windows and window components for the optimum use of renewable energy (solar gains and daylight), highest energy savings (thermal insulation) and the best indoor comfort (solar shading, daylight quality).

Scientific achievements:
The activities are grouped into 5 work packages:
WP 1 Network management and Web-site development: To provide basic conditions for networking between the members, setting up and maintenance of a Web-site and communications infrastructure of the network.
WP 2: Component and window product data, link with certification: To make a classification of different quality levels of data and to populate the software database with component properties of commercially available components and data of innovative components from research projects.
WP 3: Calculation procedures, link with standardisation and RTD priorities: To assess the quality of the calculation procedures in the WIS software package, both with respect to the application of CEN standards and with respect to the use of results from recent international research activities. To identify future RTD activities.
WP 4: Training and education: To set up a discussion platform and Frequently Asked Questions for end users of the software package on the Web-site. To develop instructions for the end users of the software and a course module for students to encourage the correct use of all its capabilities.
WP 5: Exploitation and dissemination: To prepare and organise the free-of-charge distribution of the software package for wide use in Europe in design, research, industry, education and standardisation. To make a plan for longer term continuity.
The software package already existed from previous EU RTD project (WIS, Advanced Windows Information System, EU R&D project 1994-1996), but barriers for wide spread had to be removed. The network also creates a basis for a co-operation between Europe and other regions (e.g. USA) and stimulates European harmonisation and the development and application of advanced window systems. The members of the network represent the main research teams, industries (glazing, shading, windows), consulting engineers, designers, and persons involved in CEN standardisation, building regulations and education in Europe. The duration of the project to set up the WinDat Network was 36 months.

Achievements and results:
The prime deliverable of the project is a state of the art software tool with high quality database (commercial

products and RTD data) to calculate the thermal and solar properties of advanced windows and components. Results include a Web-site with public part for WIS users and an web-based free distribution system of the software. Further results are:
A classification of data (quality, application) plus datasets on glazings, solar shading devices, edge spacers and frames.
Benchmark tests: data and test results.
User support: on line help, helpdesk, frequently asked questions, user forum, students' course, user guide.
Plans for future RTD and continuation of WinDat.
Most of the end products developed in the course of the network activities are freely available for other organisations. Representatives from other organisations interested in the network activities have been actively involved (WP1, WP5).
There is a strong wish from members for keeping the group alive, and maintain the WinDat brand name.
Consequently, the WinDat network will continue to be active in the field after the completion of the Thematic Network WinDat project (2001-2004).

Socio-economic relevance and policy implications:
The main objectives of the thematic network are to bring together key representatives from research, industry, standardisation, education and design to remove existing barriers: to make the WIS software freely available from Internet, to set up benchmark tests, to stimulate the population of the program's database with commercial products and research data and to set up a internet based user forum with technical support.
The end products developed in the course of the network will stimulate the understanding and application of European standards in the field and stimulate further standardisation of methods to assess the performance of window and façade components and assemblies.
This gained extra importance by the recent publication of the European Directive on Energy Performance of Buildings (EPBD) that requires that each Member State implements energy performance regulations for buildings before 2006 and by the associated mandate from the European Commission to CEN to develop a set of calculation methods to facilitate the Member States in this respect.
Innovative windows in the sense of energy saving and increasing comfort will lead to better social, economic and ecological working and living conditions, but also contribute to the competitiveness of the involved companies.

Conclusions:
The achievements during the project are well in line with the expectations and project plan. WinDat has proven to be an enthusiastic and devoted grouping, bringing together people with different expertise and background: research, manufacturers, designers/consulting engineers; glazings, shadings and edges/frames.

Keywords: windows, glazing, solar shading, frames, thermal properties, solar properties, daylighting properties, standardisation, software, database, design tool, energy performance, buildings

1.2 Publications (cumulative list)[1]

Not for FTR??? General rules about publicity and communications are defined within the Annex II ,"General conditions" Part B, to the contract, mainly obligations, responsibilities and reference to Community support. This should be prepared as a separate page to be annexed to the report and updated annually.

1.2.1 Peer Reviewed Articles

None

1.2.2 Non refereed literature

A poster and paper presentation on WinDat was given by the coordinator at the 2001 Northsun conference, May 2001 in Leiden (NL).
Paper:
H.A.L van Dijk, 2001. European Thematic Network WinDat. Windows as renewable energy sources for Europe - Window energy data network. Delft : TNO Building and Construction Research. Proceedings 2001 Northsun conference, May 2001 in Leiden (NL)

An oral presentation on the WinDat network was given by ENEA at Convegno Architteture di Vetro et Metallo, November 15-16, 2001 in Milano (It).

An oral presentation and abstract on the WinDat network was prepared by the coordinator in collaboration with DTU, for the Optical Radiation Measurement Club (ORM) meeting, June 27, 2002 at NPNL (UK).

A workshop was organised by TNO Bouw and Oxford Brookes University on Advanced Glazing and Active Facades, mainly concentrating on the WinDat activities, at the 3rd European Conference on Energy Perfromance and Indoor Climate (Energy Efficient and Healthy Buildings in Sustainable Cities, EPIC 2002 AIVC), October 23-26, 2002, Lyon (France)

A poster presentation and paper on the WinDat network was prepared by TNO Bouw in collaboration with Oxford Brookes University, for the 4th International Conference on Coatings on Glass (4th ICCG), Braunschweig (D), November 3-7, 2002
Paper: Dick van Dijk and Michael Hutchins,
WinDat, European RTD Thematic Network on Windows as Renewable Energy Sources for Europe – Window Energy Data Network

An oral presentation and demonstration of WIS was given by Dick van Dijk and Henk Oversloot, at the Building Simulation Conference, August 16, 2003 Eindhoven (NL).
Paper:
Dick van Dijk and Henk Oversloot,

[1] Two copies of publications issued during reporting period should be annexed to the report, specific cases should be agreed by the Project Officer

‘WIS, the European tool to calculate thermal and solar properties of windows and Window components’,
Proceedings of the Building Simulation Conference, August 16, 2003 Eindhoven (NL).

The following paper (in Dutch) was produced by the coordinator for the Dutch TVVL magazine:
Dick van Dijk, Henk Oversloot, Richard Versluis
WIS, Het Europese Rekenmodel ter Bepaling van de Warmte-, Zon- en Daglichteigenschappen van Ramen en Raamcomponenten
TNO Bouw, Delft, paper in TVVL magazine, 2004 (in Dutch)

1.2.3 Others

(Patents, CD ROM's, videos,…)

Web site: www.WinDat.org, including download option for software, documents and datafiles; including discussion forum, FAQ and helpdesk

1.2.4 Planning of future publications

(type, date, contents, …)

WIS Press Releases (See WP5, **WinDat N5.04**). These have been translated in many European languages for publication in national magazines, during summer/autumn 2004.

Continuation of web site: www.WinDat.org (see above).

1.3 Publishable Synthesis Report

This should be considered as synthesis of points 2.1 to 2.5 of Part 2 below, with no confidential information and shall be presented in a suitable form for publication with a suitable quality to enable direct reproduction. It shall include sufficient information on new developments to enable third parties established in Member States or in Associated States to be informed of opportunities

In the case where the Part 2 of the Final Technical Report does not contain any confidential information, both Part 1 and Part 2 can be combined for publication.

See next chapter 2.

2. Part 2: Detailed Final Report

2.1 Objectives and strategic aspects

A review of the overall scientific/technological and socio-economic objectives should be given with emphasis on strategic aspects, including contribution to EU policies needs.

The main objectives of the thematic network are to bring together key representatives from research, industry, standardisation, education and design to remove existing barriers: to make the WIS software freely available from Internet, to set up benchmark tests, to stimulate the population of the program's database with commercial products and research data and to set up a internet based user forum with technical support.
The end products developed in the course of the network will stimulate the understanding and application of European standards in the field and stimulate further standardisation of methods to assess the performance of window and façade components and assemblies.

At the end of the project, the WinDat network has produced the results that should lead to the planned positive socio-economic and political effects: contribution to the competitiveness of the involved companies, improved conditions for rational choice and implementation of innovative windows and window components (glazings, solar shading, daylight control and frames), leading to energy saving and increasing comfort in buildings, and consequently to better social, economic and ecological working and living conditions.

2.2 Scientific and technical description of the results

This section is the main part of the report and comprises different chapters covering the research approach and the work performed under the project, highlighting the main results achieved (deliverables). Tables, figures or charts should be used where appropriate.

Detailed report organized by work packages including data on individual contributions from each partner, related to the reporting period (12 months). Max. 4 pages per work package (Confidential)

2.2.1 General

2.2.1.1 Objectives

Overall objectives of the project:
The aim of the WINDAT network is to make available and widely distribute a free, European software tool with high quality input and output for the calculation of the thermal and solar properties of commercial and innovative window systems on the basis of known component (glazings, shading devices, frames and edges, gases,..) properties and thermal and solar/optical interactions between the components. Both for standard product information (based on routines from European standards) and for more advanced calculations (design conditions) and for innovative products for which no European standards exist yet.

A tool that is collectively supported and used in research, industry, standardisation, education and design throughout Europe to compare, select and promote innovative windows and window components for the optimum use of renewable energy (solar gains and daylight), highest energy savings (thermal insulation) and the best indoor comfort (solar shading, daylight quality).
Therefore, to remove the barriers for the wide use of an updated WIS package that is developed and supported in Europe, adopts and anticipates European standards and data from European products and research.

The network will also create a basis for co-operation between Europe and other regions. In particular, on the basis of mutual benefit, collaboration will be sought with the USA with respect to software and databases developed within the framework of the National Fenestration Rating Council (NFRC).

The network will stimulate European harmonisation.
Innovative windows in the sense of energy saving and increasing comfort will lead to better social, economic and ecological working and living conditions, but also contribute to the competitiveness of the involved companies.

The main results are:

- Organisation of the Work Packages
- Set up of the web site (public and private)

- Classification of component data and specify component data formats and submission procedures of commercial data
- Collection of sets of component data for inclusion in WIS database
- Preparation of free distribution and registration of the WIS software
- Set of benchmark tests, WIS evaluation reports, detailed examples and course module for students
- Set up of WIS user support
- Procedures for link to building simulation tools
- RTD plan for future activities
- Promotion and distribution of improved version of WIS via web site
- Plan for longer term future of the network

Work Packages:

The Workplan consists of five Work Packages, listed below:

WP 1: Network management and Web-site development
WP 2: Component and window product data, link with certification
WP 3: Calculation procedures, link with standardisation and RTD priorities
WP 4: Training and education
WP 5: Exploitation and dissemination

The interaction between the five WP's is given in figure 2-1.

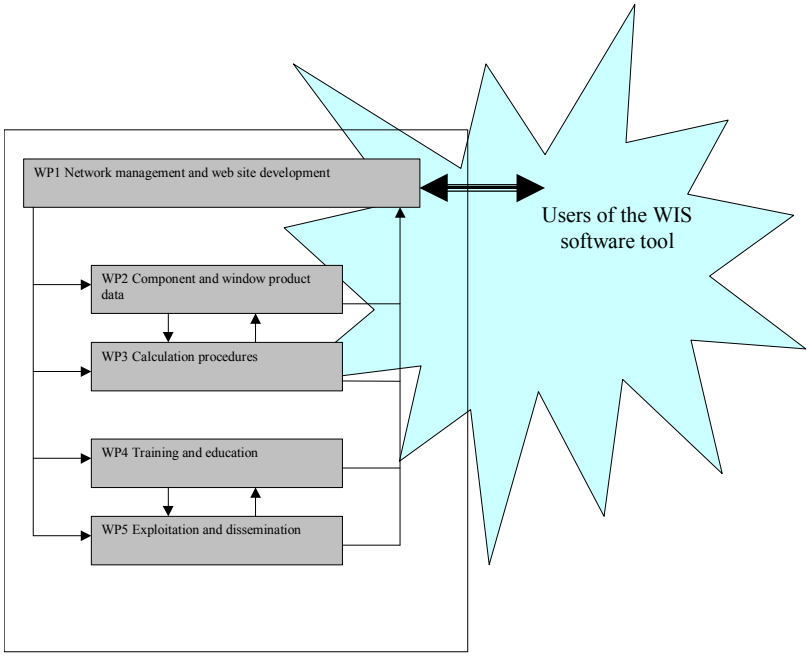


Figure 2-1: Interaction between the five WP's

2.2.1.2 List of Final WinDat Documents

In addition to this Final Technical Report a high number of final documents were produced within WinDat, either confidential (for use within WinDat and the European Commission), or public.
The public documents will be uploaded to the public part of the WinDat web site at short notice.

N1.01 Dijk, H.A.L. (Dick) van,
WinDat Final Technical Report, Public Part,
TNO Building and Construction Research, Delft (NL), July 2004. **Public**.

N1.02 Dijk, H.A.L. (Dick) van,
WinDat Final Technical Report, Confidential Part,
TNO Building and Construction Research, Delft (NL), July 2004.
Confidential.

N1.03 Dijk, H.A.L. (Dick) van,
WinDat Technology Implementation Plan,
TNO Building and Construction Research, Delft (NL), July 2004.
Confidential.

N2.01 Hutchins, Michael and Neviana Kilbey,
WIS Database. Data Submission Procedure for Glass and Coatings (non-scattering) Glazing Products, version 1.0,
Oxford Brookes University, School of Technology, Oxford (UK), May 2004.
Public.

N2.02 Hutchins, Michael and Neviana Kilbey,
WIS Database. Verification Procedures for Glass and Coatings (non-scattering) Glazing Products Data, version 1.0,
Oxford Brookes University, School of Technology, Oxford (UK), May 2004.
Public.

N2.03 Hutchins, Michael and Neviana Kilbey,
WIS Database. Optical Properties Database for Glass and Coatings (non-scattering) Glazing Products Data,
Oxford Brookes University, School of Technology, Oxford (UK), May 2004.
Confidential.

N2.04 Hutchins, Michael and Neviana Kilbey,
UV/VIS/NIR Spectrophotometric Near-normal Specular Transmittance and Reflectance Measurement Intercomparision – Initial Sample Characterisation,
Oxford Brookes University, School of Technology, Oxford (UK), May 2004.
Public.

N2.05 Hutchins, Michael and Neviana Kilbey,
UV/VIS/NIR Spectrophotometric Near-normal Specular Transmittance and Reflectance Measurement Intercomparision – Instructions,
Oxford Brookes University, School of Technology, Oxford (UK), Feb. 2004.
Public.

N2.06 Hutchins, Michael and Neviana Kilbey,
UV/VIS/NIR Spectrophotometric Near-normal Specular Transmittance and Reflectance Measurement Intercomparision – Results,
Oxford Brookes University, School of Technology, Oxford (UK), May 2004. **Public**.

N2.07 Rosenfeld J.L.J.,
WIS Database. Data Submission Procedure for Shading and Diffusing Components, version 1.0,
Technical University of Denmark, Dep. Of Civil Engineering, Lyngby (Dk), May 2004. **Public**.

N2.08 Rosenfeld J.L.J.,
WIS Database. Master List of Producers of Window-covering Products,
Technical University of Denmark, Dep. Of Civil Engineering, Lyngby (Dk), April 2004. **Confidential**.

N2.09 Pedersen, F., J. B.Laustsen, S. Svendsen,
A method for Characterizing the Thermal Properties of Windows Frame Profiles,
Technical University of Denmark, Dep. Of Civil Engineering, Lyngby (Dk), September 2003. **Public**.

N2.10 Pedersen, F.,
Solving non-linear data fitting problems using DataFit 8.0.
Technical University of Denmark, Dep. Of Civil Engineering, Lyngby (Dk), March 2004. **Public**.

N2.11 Laustsen, J. B., S. Svendsen,
WIS Database. Data Submission Procedure for Databases on Spacer Profiles, Edge Constructions and Window Frame Profiles, version 1.0,
Technical University of Denmark, Dep. Of Civil Engineering, Lyngby (Dk), March 2004. **Public**.

N2.12 Laustsen, J. B., S. Svendsen,
WIS Database. Status of Database on Spacer Profiles, Edge Constructions and Window Frame Profiles,
Technical University of Denmark, Dep. Of Civil Engineering, Lyngby (Dk), March 2004. **Confidential**.

N2.13 Svendsen, S.,
WIS Database. Links to Certification Schemes.
Technical University of Denmark, Dep. Of Civil Engineering, Lyngby (Dk), March 2004. **Public**.

N3.01 Platzer, Werner,
Description of Benchmark Cases for Window and Shading Performance Calculation,
Fraunhofer Institute for Solar Energy, Freiburg (D), January 2003. **Public**.

N3.01App_1: XLS file with data: :
File: <*WinDat_N3.01APP_1_Benchmark_Data-v2_28.01.03.xls*> **Public**

N3.01App_2: XLS file with output format: :
File: <*WinDat_N3.01APP_2_Benchmark_Results_XXXX.xls*> **Public**

N3.02 Heimonen, Ismo[1], Henk de Bleecker[2],
Description of Benchmark Cases for Double Skin Facades,

[1)]VTT (Fin), [2)]Permasteelisa R&D, June 2003. **Public**.

N3.02App_1: XLS file with DSF benchmark data:
File: <*WinDat_N3.02APP_1_Benchmark_Data_DSF_v1_31.03.03.xls*>
Public

N3.02App_2: XLS file with reporting format:
File: <*WinDat_N3.02APP2_Benchmark_Results_DSF_31.03.03.xls*> **Public**

N3.03 Platzer, Werner,
CEN-Benchmark Calculations for Glazings using WIS 2.0b,
Fraunhofer Institute for Solar Energy, Freiburg (D), May 2004. **Public**.

N3.04 Platzer, Werner,
Evaluation of Benchmark cases for Window and Shading Performance Calculation,
Fraunhofer Institute for Solar Energy, Freiburg (D), March 2004. **Public**.

N3.04App_1: XLS file with all results:
File: <*WinDat_N3.04APP_1_Benchmark_Results_all_27.02.04.xls*>
Confidential

N3.05 Lars Olsen[1], Lars, Karsten Duer[2] and Ray Williams[3],
Evaluation of U-value algorithms in WIS (EN 673),
[1)]Danish Technological Institute, [2)]VELUX A/S and [3]NPL Management Ltd,
Copenhagen (Dk), May 2004. **Public**.

N3.06 Platzer, Werner,
Evaluation of Program Calculation Procedures according to Standards EN673 and EN 410**,**
Fraunhofer Institute for Solar Energy, Freiburg (D), March 2004. **Public**.

N3.07 Dijk, H.A.L. (Dick) van and Leo Bakker,
Algorithms in WIS on Ventilation in Gaps,
TNO Building and Construction Research, Delft (NL), April 2002. **Public**.

N3.08 Dijk, H.A.L. (Dick) van and Richard Versluis,
Definitions of Thermal and Solar Properties of a Vented Window or Facade,
TNO Building and Construction Research, Delft (NL), May 2004. **Public**.

N3.09 Hand, J W, I.A. Macdonald and P.A. Strachan,
Requirements for Thermal and Lighting Simulation Programs,
University of Strathclyde, Energy Systems Research Unit, Glasgow (UK),
May 2004. **Public**.

N3.10 Platzer, Werner,
Identification of Future Requirements for Research and Development - RTD Plan,
Fraunhofer Institute for Solar Energy, Freiburg (D), July 2004. **Confidential**.

N4.01 Dijk[1], Dick van, Leo Bakker[1] and Paul Kenny[1],
WIS 1.0 User Experience,
[1)]: TNO Building and Construction Research, Delft (NL),
[2)]: University College Dublin, Energy Research Group, Dublin (Ireland),
March 2002. **Confidential**.

N4.02 Dijk, H.A.L. (Dick) van,
User Guide for WIS version 2.0.1 – Examples of Windows as Input for WIS,
TNO Building and Construction Research, Delft (NL), November 2003.
Public.

N4.02App_1: ZIP file with example data files:
File: <*WinDat_N4.02APP_1_Datafiles_User_Guide_WIS-2.0.1_Nov_03.zip*>
Public

N4.03 Frank, Th. And Th. Nussbaumer,
WinDat Training and Education. Training Course. Introduction
EMPA, Applied Physics in Buildings, July 2004. **Public**.

N4.03App_1: PPT file with Course Module 1:
File: <WinDat_N4.03_APP_1_Module 1 - Basic Physics on thermal and optical properties_v.28.07.04.ppt>, July 2004 **Confidential**

N4.03App_2: PPT file with Course Module 2:
File: <WinDat_N4.03_APP_2_Module 2 - Window component characteristics_v.28.07.04.ppt> **Confidential**

N4.03App_3: PPT file with Course Module 3:
File: <WinDat_N4.03_APP_3_Module 3 - The WIS program_v.28.07.04.ppt>
Confidential

N4.03App_4: PPT file with Course Module 4:
File: <WinDat_N4.03_APP_4_Module 4 - Building energy simulation_v.28.07.04.ppt> **Confidential**

N4.04 Versluis, Richard,
On Line Help on WIS version 3.0.1 – PDF version,
TNO Building and Construction Research, Delft (NL), July 2004. **Public**.

N5.01 Dijk, H.A.L. (Dick) van,
WIS Download Procedure,
TNO Building and Construction Research, Delft (NL), July 2004.
Confidential.

N5.02 Hernandez, Patxi,
Evaluation of Software Distribution and Promotion Process,
University College Dublin, Energy Research Group, Dublin (Ireland), July 2004. **Confidential**.

N5.03 Hernandez[1], Patxi and Dick van Dijk[2]
Plan for Longer Term Future of the Thematic Network WinDat,
[1)]: University College Dublin, Energy Research Group, Dublin (Ireland);
[2)]: TNO Building and Construction Research, Delft (NL),
July 2004. **Confidential**.

N5.04 Hernandez[1], Patxi and Richard Versluis[2]
Press Releases on WIS version 3.0 in various European Languages,
[1)]: University College Dublin, Energy Research Group, Dublin (Ireland);
[2)]: TNO Building and Construction Research, Delft (NL),
July 2004. **Public**.

2.2.2 Work Package 1 Network management and web site development

2.2.2.1 Work programme WP1

Objectives :

To provide the basic conditions for networking between the members, including communication with the WP leaders and the members, the activities of the Steering Committee, the network secretariat (members administration, contracts administration, compilation of progress reports, cost statements, organisation of main meetings, etc.), the setting up and maintenance of the Web-site and the communications infrastructure of the network.

Description of work/tasks:

General co-ordination:

The networking includes communication with the WP leaders and the members, the activities of the Steering Committee, the network secretariat (members administration, contracts administration, compilation of progress reports, cost statements, organisation of main meetings, etc.), the setting up and maintenance of the Web-site and the communications infrastructure of the network.

The first task is to make inventory and organise the participation of the members in the working packages and completing the trio-leaderships of the WP's.

Specific task: Development of Web-site.

The Web-site will consist of 3 parts:

- A public part, which will include information on the objectives and activities of the network and information on the WIS software package.
- A part only accessible by the Network members. This part will e.g. include the working documents
- A part for the users of the software package.

Deliverables:

Communication and information structure between the members.

Web-site for dissemination of information to outside and for internal communication within the network and for the users of the software package.

2.2.2.2 Methodology and scientific achievements related to WP1

Work Package leader:

Dick van Dijk and Richard Versluis (from August 2003, replacing Marleen Spiekman) (TNO Bouw, NL)

Assisted by the following Steering Committee members:

Michael Hutchins (Brookes University, UK)

Mat Santamouris (and colleagues) (university of Athens, Gr)

Other Steering Committee members, representing WP2-WP5:

Svend Svendsen (University of Denmark, Dk)

Werner Platzer (Fraunhofer Institute for Solar Energy, D)

Thomas Frank (EMPA, CH)

Vivienne Brophy/Patxi Hernandez (replacing Paul Kenny; University College Dublin, IRL)

Thematic Network structure:
In general, a Thematic Network knows 3 levels:

- Co-ordinator of the project
- Principle Contractors
- Members

Each member is linked to one of the Principle Contractors.
The Co-ordinator and Principle Contractors sign the contract with the EC ('basic contract').

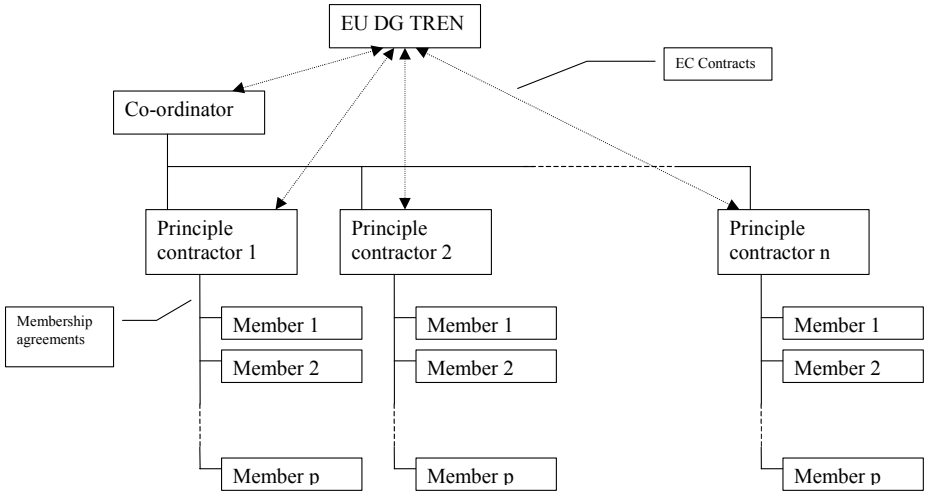


Figure 2-wp1.1 General structure of a European Thematic Network

In WinDat the structure is simpler:

TNO is the co-ordinator and also the only principle contractor, all members are linked to TNO as the principle contractor.

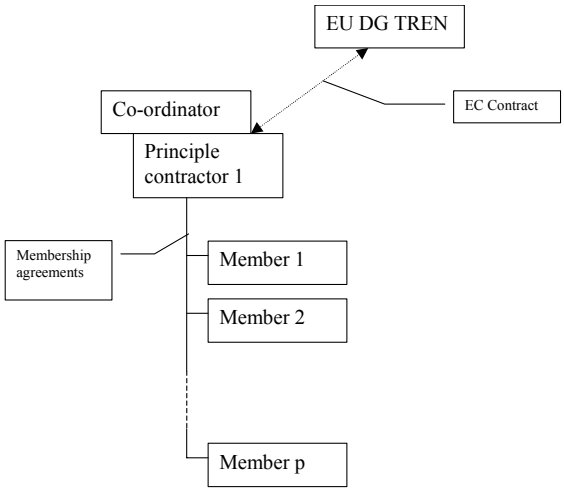


Figure 2-wp1.2 Structure of Thematic Network WinDat

Leadership WP2-WP5:
In order to avoid a too heavy structure it was decided at the first plenary meeting to concentrate on the set up of subgroups with subgroup-leaders and –participants for the working packages where a subdivision into subgroups was needed.

Consequently, subgroups were set up under WP2 and WP3 (see next sections):

The subgroups could be updated when needed during the course of the project.
See chapter 3.3.3 for a detailed overview of the participation in Work Packages (WP) and Sub Groups (SG).
The participation list is kept up to date at the private part of the WinDat web site.
A special form gives direct access to the WinDat member database with:

- For each WP or SG: the currently participating persons
- For each person: the current subscription to each WG and/or SG.

See figure 2-wp1.3.

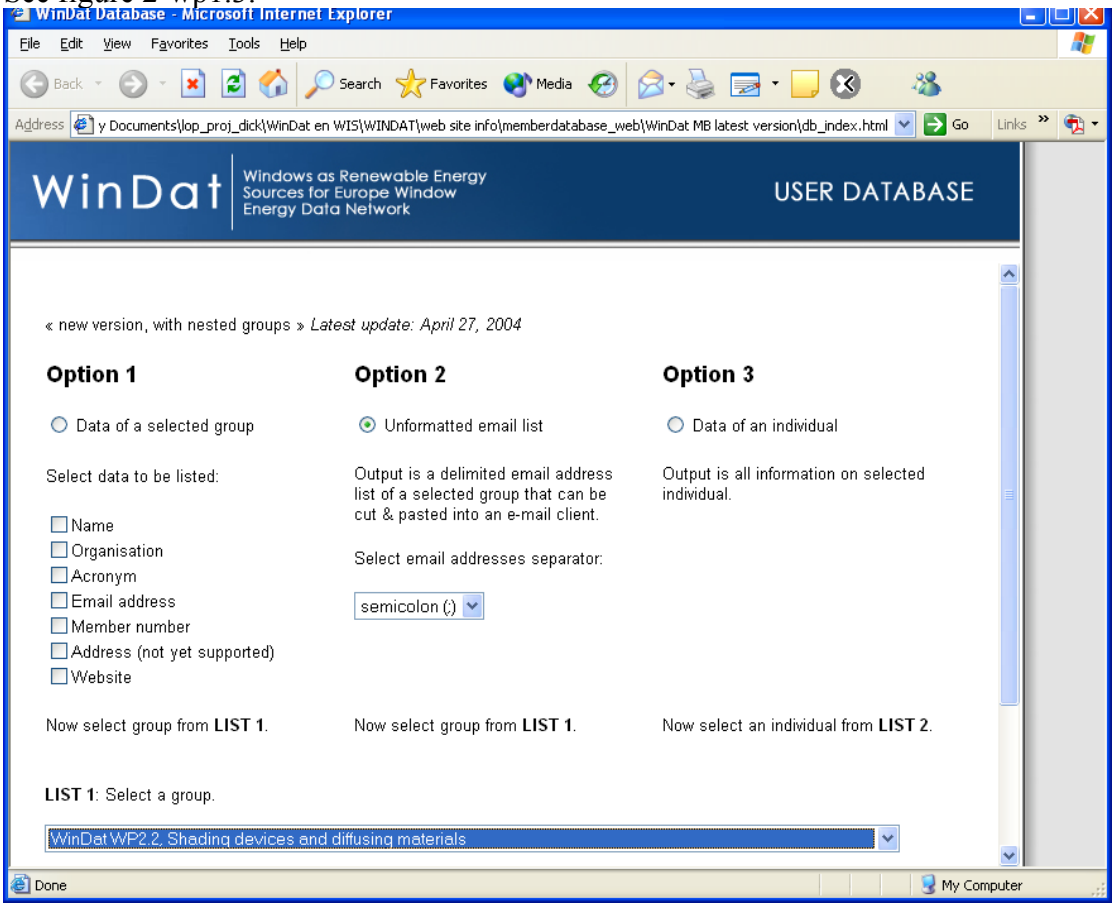


Figure 2-wp1.3, WinDat members database at private part of the WinDat web site

Meeting schedule:
Also at the first plenary meeting it was decided to combine the plenary and work package meetings. As a result, there were 2 plenary meetings each year, with parallel sessions for Work Packages or Sub Groups where needed.

Table 2-1.1 Meeting schedule

#	Date	Place	Status	Remarks
1	September 13-14, 2001	Delft	Done	
2	March 14-15, 2002	Zurich	Done	
3	September 12-13, 2002	Athens	Done	
4	April 10-11, 2003	Dublin	Done	
3	September 11-12, 2003	Copenhagen	Done	
6	March 25-26, 2004	Brussels	Done	Final meeting

Management:
The daily co-ordination was performed by the co-ordinator.

The **Steering Committee** assisted in the clustering and exchange of information from the different work packages and the preparation of meetings and actions and the control of the overall progress of the work.
Preparatory meetings of the Steering Committee preceded the regular plenary meetings of the Network. If necessary, they may meet in between.

The WP leadership was regularly contacted by the Co-ordinator about the progress of the work and about the need, if any, to adapt the work programme and schedule.

Follow up of the commitments was done through an **action list** with clear indications of the agreed actions, the responsible person or institute and the deadline. Normally the updates of the action lists are part of the meeting Minutes. The Minutes of the meetings also contain a **list of decisions**.

Minutes of the meetings were made available as soon as possible after each meeting and distributed via e-mail. All minutes are also available on the network.

All relevant **documents** are available in electronic format, if possible.

The **Web-site** is the main core of the information exchange system. See also WP5.

Consortium:
The consortium consists of organisations that comprise both research and/or education organisations, industry, consulting engineers and designers. There is a limitation to the manageable number of members. A limited number of organisations with great and active interest in the Network could be invited as External Partner. Other organisations will be kept informed about the network via individual (e.g. national) contacts, in order to efficiently obtain feed back and dissemination of the results.

The involvement of each of the members in the various tasks and work packages is indicated by the number of person-days allocated to the WinDat activities.

For External Partners, an external partnership agreement, similar to the membership agreement for the members, has been drawn up to describe the rights and obligations of an External Partner. An External Partner does not receive funding from the European Commission for participation in the Network. An External Partner could be charged for extra costs, e.g. for participating at Network's meetings.

There are two External Partners in the project (see 3.3.3).

Via the activities of WP4 there was a close and instantaneous link to and from the platform of the current and new users of the software package.

Web site:
The web site was fully operational from an early phase in the project; see http://www.windat.org. It includes a private part for internal communication.
In the first years there were regularly problems with external access to the server, due to a difficult to detect bug in one of the routers at UCD (Dublin). These problems were solved before the last year of the project.

The information of each working package is available to all members of the network via the Web-site.

Collaboration:
Regular (personal) contacts were maintained with e.g. the following related international activities:

- CEN TC 89 and ISO TC163 (Thermal Performance of Buildings, including working groups on thermal and solar properties of windows); e.g. resulting in:
  We mention just a few of the relevant actions from WinDat members in CEN or ISO:
  - WinDat members contacted ISO TC163 WG9 in order to prepare a proposal to add the two-box method as additional normative method in the relevant standard (EN ISO 10077-1).
  - WinDat members were involved in the CEN TC89 WG7 ad hoc group to investigate the possibilities to adopt ISO 15099 (detailed calculation of thermal and solar properties of windows) as CEN standard. There are a

number of serious discrepancies between several standards within ISO itself, and even more with several CEN standards.
    - WinDat members commented on draft Product Standard for e.g. U and g-value for windows, because it would not be in line with the needs for energy and comfort calculations.
    - WinDat members commented on draft simplified CEN method for curtain walls, because it would not produce conservative values, compared to a detailed numerical calculation method. Later on, WinDat members contributed actively with calculations and proposals for definitions and equations, leading to a new draft standard.
- ICG TC10 (Coated glazings); mainly with WP 2.1 and 2.2
- IEA SHC Task 27 (Performance of Solar Façade Components); mainly with WP3 benchmarks
- EU Thermes (on emissivity of coated glazings; mainly with WP2.1)
- EU T.N. Enerbuild (Energy and Buildings)
- EU T.N. IQ-Test (Quality of Testing and Evaluation Solar and Thermal Characteristics of Building Components)
- EU Save project EWERS (Development of European Window Energy Rating)

  The EU Save project EWERS (European Window Energy Rating) has been completed. Information on the final products can be found at http://www.bfrc.org/save/index.htm. There is a close link with WinDat, because EWERS refers to the database and (CEN based) calculation routines in WIS and relied on WinDat for that.
- EU Save project ENPER (European Collaboration in relation to Energy Performance Regulation for Buildings and Model Code Development)

In addition, close contact is maintained with NFRC (National Fenestration Rating Council, USA) and LBNL (Lawrence Berkeley Lab, USA), in particular related to issues under WP2.1.

2.2.3 Work Package 2, Component and window product data, link with certification

2.2.3.1 Work programme WP2

Objectives :
WP2 classifies different quality levels of data and provides the necessary information to populate the WIS software databases with component properties of commercially available components and data of innovative components obtained as outputs from research projects.

Description of work/tasks:
The following activities are planned:

- To make a classification of different quality levels (classes) of data (e.g. generic, certified products, prototype test results, etc.).
- To link to international certification schemes for thermal and solar properties of window components or windows which are available or under development (CEN, UEATC, EOTA).
- To set up WEB based system of downloadable manufacturers data, either at the individual manufacturers and/or at the Network's Web-site.
- To make the necessary software modifications to accommodate the downloading of data sets.
- To stimulate the submission of appropriate and available sets of detailed properties of components from members and third parties.
- To collect appropriate and available (non-confidential) sets of detailed properties of components data from research.
- To make a link to data needed for window energy rating.
- To seek collaboration with similar activities in other countries (e.g. USA).

Recommendations for future actions.

Deliverables:
Classification of data according to their quality and application range.
Structured database populated with component data (commercial and from research)

2.2.3.2 Methodology and scientific achievements related to WP2

Work Package leader:
Svend Svendsen (University of Denmark, Dk)

Progress in general:
WP2 is divided into 3 Sub-Groups which deal respectively with the optical and thermal properties of (i) non-scattering glass and coated glass products, (ii) scattering glazing and solar protection devices, (iii) frame and edge seal components:

WP2.1: Glass and coatings (non-scattering) ("GCNS")

Co-ordination: Michael Hutchins (Brookes)

WP2.2 Shading devices and diffusing materials
Co-ordination: Jean Rosenfeld (DTU)

WP2.3. Edge seals, frames and windows
Co-ordination: Svend Svendsen (DTU)

WP2.1: Glass and coatings (non-scattering) (➔ "GCNS")

The WP2.1 Glass and Coatings (Non-Scattering) (GCNS) Sub-Group was coordinated by Oxford Brookes University and chaired by Prof M G Hutchins. Membership of the Sub-Group comprised the representatives of major European glass and glazing manufacturers, research organisations and universities drawn from within the membership of the WinDat Thematic Network. The full membership of the Sub-Group is given in Appendix WP2.1 – 1.

The principal tasks of WP2.1 were to:

- Establish an agreed procedure for the submission of spectral optical properties data for glass and coated glass products from European manufacturers
- Establish an agreed procedure for the review and approval of submitted optical properties data
- Prepare the submission of approved optical properties data for inclusion in the WIS database
- Develop procedures for ensuring the validity, accuracy and reliability of optical properties data contained within the WIS database and compliance with all relevant European norms
- Ensure collaboration with other international glass and glazing optical properties databases and where possible develop links and processes which promote harmonisation of product data
- Maintain an accurate record and history of optical properties data obtained through the working of the WinDat thematic network
- Provide information in support of other workpackages within WinDat

Data submission and approval procedures for the spectral optical properties of glass and coated glass products from European manufacturers

Following consultation and review by members of the WP2.1 GCNS Sub-Group a draft procedure for the submission of spectral optical properties data of transparent uncoated and coated glass products was agreed (D4[2]). The procedure defines the principal categories of glazing product, e.g. uncoated, coated, laminate etc., the physical properties of the product which need to be provided when submitting data,

[2] The D-numbers refer to the WinDat project deliverables

e.g. thickness, thermal conductivity, emissivity, coating position, EN1096 coating class [9] etc., and details of the product name and manufacturer. File formats for the electronic submission of the spectral transmittance and reflectance in the spectral range 2500-300 nm were agreed and compatibility with data submission requirements for the International Glazing Database (IGDB) [8] was sought wherever possible. A draft procedure for reviewing data submitted was agreed and the review process undertaken by the Sub-Group (D4). Approved data were consolidated and made ready for incorporation in the WIS database (D8).

During the WinDat project these data submission procedure and the data review procedure were employed, reviewed and amended to produce two final documents [1,2] (D21) and data continually added to the WIS database (D22).

An accurate record and history of the spectral optical properties of data submitted by the European manufacturers was maintained through the development of an in-house Access database [3] which enables complete records to be kept of all data submitted and approved.

An example of a data file header for the submission of spectral optical properties data is shown in Fig. 2-wp2.1.1

```
{ Units, Wavelength Units } SI Microns
{ Thickness } 2.997
{ Conductivity } 0.187
{ IR Transmittance } TIR=0
{ Emissivity, Front Back } Emis= 0.9 0.9
{ }
{ Product Name: SolarBest }
{ Manufacturer: ABCD }
{ Type: Monolithic }
{ Material: Acrylic }
{ Coated Side: Neither }
{ Angle of Incidence: 30 }
{ Appearance: Clear }
{Coating Class: UU}
0.300   0.003   0.042   0.043
0.305   0.005   0.042   0.043
```

Figure 2-wp2.1.1 Example of the Header of a WinDat Spectral Optical Properties file for the submission of data on non-scattering glass and coated glass products (Example 1: A monolithic glazing product: with transmittance and reflectance measured at 30° angle of incidence). The spectral data in the last 2 rows are submitted as Wavelength (microns), Transmittance, Reflectance (Side 1), Reflectance Side 2.

During the WinDat project the spectral optical properties of 164 glazing products were approved and uploaded to the WIS database. A summary of the numbers of each product by glazing type, i.e. monolithic (uncoated), coated and laminate, as submitted by 4 European manufacturers is shown in Table 2-wp2.1.1.

Manufacturer	Coated	Laminate	Monolithic	Total
Glaverbel S.A.	80	14	7	101
Interpane Glas Industrie AG	11		2	13
Pilkington	2	3	40	45
Saint Gobain Glass	2	1	2	5
Total (to 31 May 2004)	95	18	51	164

Table 2-wp2.1.1 Summary of the numbers of each product by glazing type submitted by 4 European manufacturers and approved for inclusion in the WIS database.

An example of the Brookes WP2.1 spectral optical properties Access database accurate used to manage data submitted by the European manufacturers is shown in Fig. 2-wp2.1.2.

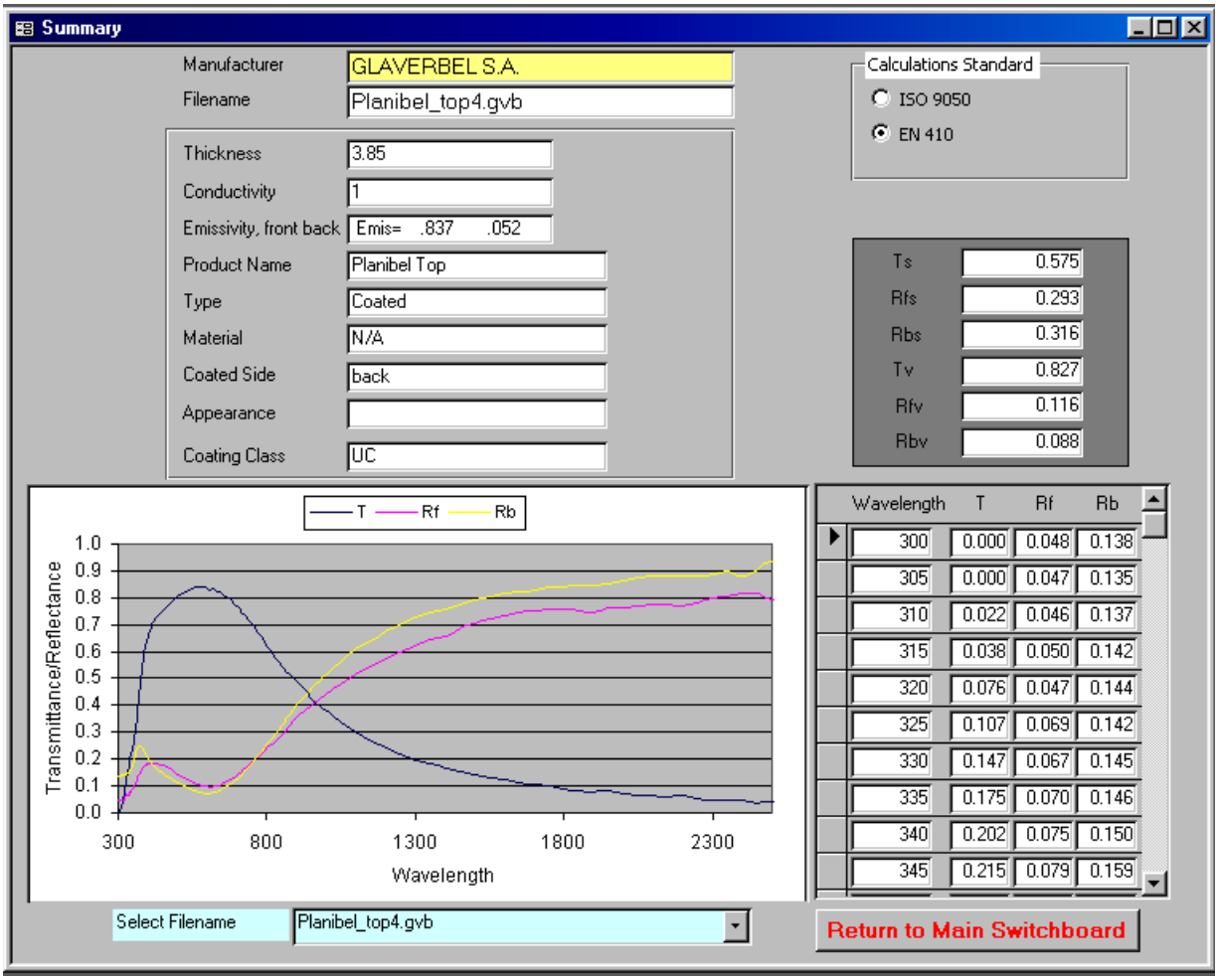


Figure 2-wp2.1.2 Example screen of the Brookes WP2.1 spectral optical properties database developed for management of WinDat data submission and approval.

Data Quality Assurance

The data review process was expanded to include provision for assuring the quality of spectral optical properties data stored within WIS and to promote confidence by users in the accuracy and reliability of the data. The review process requires all manufacturers submitting data to participate in an measurement intercomparison of the spectral optical properties of uncoated and coated glass products. To this effect an interlaboratory comparison of the measurement of spectral transmittance and reflectance at near-normal incidence was undertaken in the third year of the WinDat project.

4 samples of commercially available products were selected. Sufficient samples were procured to enable all participants to receive and retain an individual set for measurement. The spectral reflectance and transmittance in the range 2500-300 nm of all samples were first measured by the intercomparison coordinator, Brookes to enable closely characterised and similar sample sets to be prepared for delivery to the participants [4].

The involvement of the participants from the European glass and glazing industry, research institutes and universities specialising in optical properties measurements was sought. 13 participants from 8 EU Member States undertook the measurements.

A written set of instructions, defining the measurement procedures and the required data-reporting format, was prepared [5] and distributed to each participant together with a purpose designed data workbook prepared in Excel format for the return of the measured data. The participants were required to use their own traceable reference standards and the spectral data were to be supplied corrected for the optical properties of the standard used where necessary. Each participant was also required to calculate and report the integrated solar and visible optical properties using the procedures defined in the European standard EN410 [7] and to submit both the measured spectral data and the integrated results according to the specified data format.

The results of the intercomparison are presented in detail elsewhere [6]. All measurements were referenced to the initial characterisation undertaken by Brookes. As examples Fig. 2-wp2.1.3 shows the interlaboratory comparison of the differences between each laboratory and the Brookes initial characterisation values by participant (Box Number) for Sample 04. Fig 2-wp2.1.4 shows the Standard Deviation of the differences in the integrated optical properties between the calculated laboratory and Brookes values averaged for all measurements for each sample (the outliers are excluded).

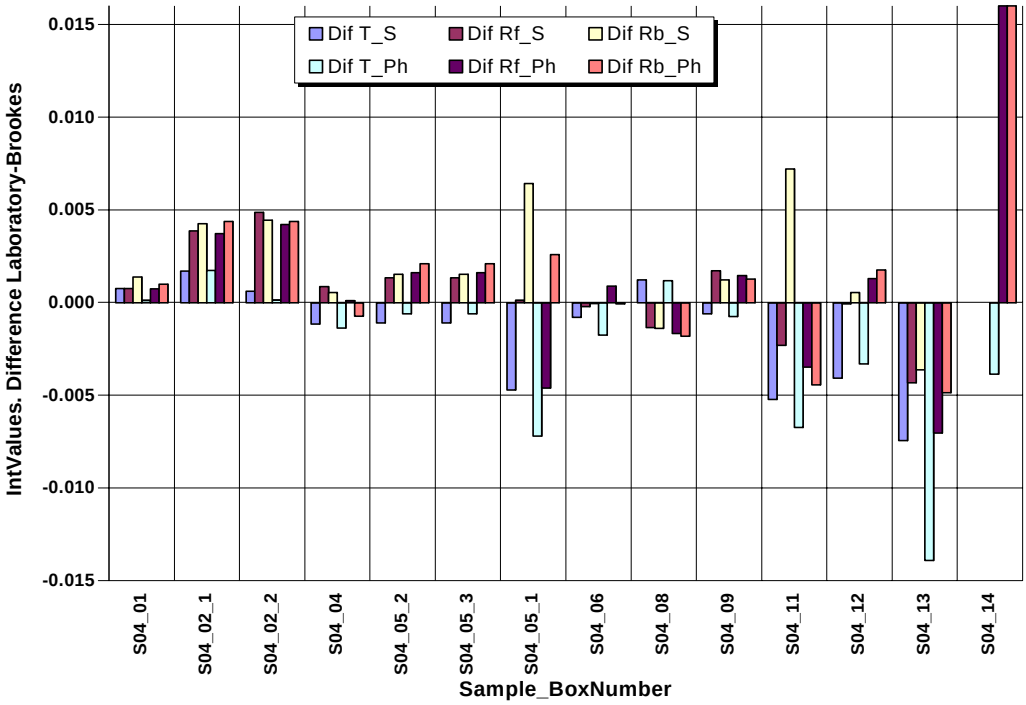


Figure 2-wp2.1.3. Interlaboratory comparison of the differences between the laboratory and Brookes integrated optical properties values (solar and photopic) by Participant (Box Number) for Sample S04.

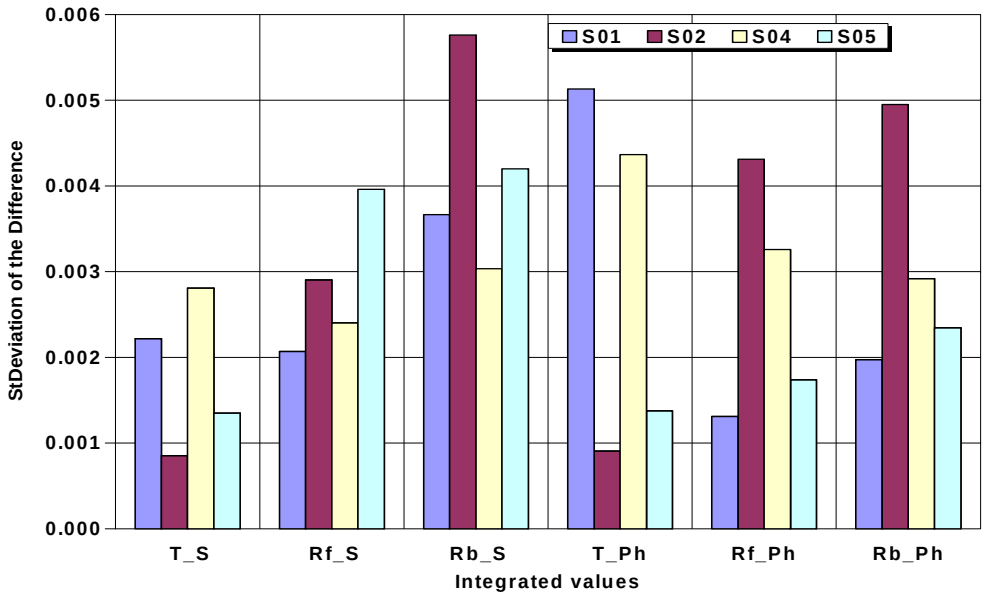


Figure 2-wp2.1.4 Standard Deviation of the differences between the laboratory and Brookes integrated optical properties values for all measurements (transmittance and reflectance; solar and visible (photopic) for each of the 4 samples.

The overall outcomes of the WinDat UV/Vis/NIR spectral transmittance and reflectance measurement intercomparison exercise are very encouraging. Participants performed the work using a range of instruments and internal reference materials. The measurements performed by most of the participating laboratories are in very good agreement. The Mean deviation of the differences between the laboratory and Brookes integrated optical properties values averaged for all measurements for each sample is less than $\pm$ 0.006. The Standard deviation of the differences between the laboratory and Brookes integrated optical properties values for all measurements for each sample is less than 0.006.

It is concluded that the participants performed the measurements accurately and this provides confidence in the quality of the spectral optical properties data held in the WIS database for non-scattering glass and glazing products.

Conclusions

The WinDat WP2.1 Glass and Coatings (Non-Scattering) has succeeded in completing all planned activities defined in the Technical Annex. A strong nucleus of European manufacturers, research institutes and universities have established a firm basis for the dissemination of technical information on the optical properties of commercially available glass and glazing products in forms suitable for the purpose of window design and estimation of energy performance in buildings. In addition strong links have been created with the USA and positive steps taken towards achieving integration and harmonisation of performance description of glass and glazing

products through integration and compatibility with the International Glazing DataBase (IGDB). These achievements ensure that data collection and integration within WIS can continue successfully following completion of the initial WinDat EC-funded duration.

All milestones have been reached and deliverables produced. Data submission and review procedures have been rigorously developed and approved. Harmonisation with all relevant European standard norms has been achieved. Database management is efficiently maintained through the use of the purpose built WinDat WP2.1 optical properties database. The quality of data held within WIS has been positively reinforced by undertaking interlaboratory comparisons of measured data provided by all participants submitting data for inclusion in WIS.

References

1. Hutchins M G and Kilbey N B, WIS Database, Data Submission Procedure for Glass and Coatings (non –scattering) glazing products, Version 1.0, **WinDat N2.01**, May 2004 (**public**).

2. Hutchins M G and Kilbey N B, WIS Database, Verification Procedure for Glass and Coatings (non –scattering) Glazing Products Data, Version 1.0, **WinDat N2.02**, May 2004 (**public**).

3. Hutchins M G and Kilbey N B, WP2.1 Optical Properties Database for Glass and Coatings (non –scattering) Glazing Products Data, **WinDat N2.03**, May 2004 (**confidential**).

4. Hutchins M G and Kilbey N B, WP2.1Measurement Intercomparison_ Glass and Coatings (non-scattering) - Initial Sample Evaluation, **WinDat N2.04**, February 2004 (**public**)..

5. Hutchins M G and Kilbey N B, UV/Vis/NIR Spectrophotometric Near-Normal Specular Transmittance and Reflectance Measurement Intercomparison - Instructions, **WinDat N2.05**, February 2004 (**public**)..

6. Hutchins M G and Kilbey N B, UV/Vis/NIR Spectrophotometric Near-Normal Specular Transmittance and Reflectance Measurement Intercomparison - Results, **WinDat N2.06**, May 2004 (**public**)..

7. EN 410 Glass in building – Determination of luminous and solar characteristics of glazing, April 1998.

8. R. Versluis, R.Powles, M. Yazdanian, M. Rubin, International Glazing Database: Data Submission Procedure (http://windows.lbl.gov/materials/IGDB/Documentation/Documentation.htm).

9. EN 1096-1 Glass in building – Coated glass – Part 1: Definitions and classification, Nov 1998.

Appendix WP2.1 – 1

Members of the Glass and Coatings (Non-Scattering Sub-Group)

The members of the current GSNS Sub-Group are listed in the table below. The list is not constant and will be updated regularly in the WIS website.

Name	Organisation	Acronym
Mr Dick van Dijk	TNO Building and Construction Research	TNO Bouw
Mr Richard Versluis	TNO Building and Construction Research	TNO Bouw
Mr Peter van Nijnatten	TNO Institute of Applied Physics	TNO TPD
Mr Thomas Nussbaumer	Swiss Federal Laboratories for Materials Testing and Research	EMPA
Mr Michael Hutchins	Oxford Brookes University	Brookes
Mrs Neviana Kilbey	Oxford Brookes University	Brookes
Mr Jean Roucour	Glaverbel	Glaverbel
Mr Frank Rubbert	Saint-Gobain Glass Deutschland GmbH	SGGD
Mr Nils-Peter Harder	Saint-Gobain Glass Deutschland GmbH	SGGD
Ms Helen-Rose Wilson	Interpane Entwicklungs- und Beratungs-gesellschaft	Interpane
Mr Karl Haeuser	Interpane Entwicklungs- und Beratungs-gesellschaft	Interpane
Mr Ismael Rodriguez Maestre	Universidad de Cádiz	UCA
Mr Bruno Chevalier	Centre Scientifique et Technique du Bâtiment, the Materials Department	CSTB MD
Mr Franco Geotti-Bianchini	Stazione Sperimentale del Vetro	SSV
Mr Arne Roos	Uppsala University	Upps
Mr Jaap de Nijs	Guardian Luxguard	Guardian
Mr Francesco Tritta	Guardian Luxguard	Guardian
Mr Robert Davies	Pilkington	PKT
Mr Svend Svendsen	Technical University of Denmark	TUD
Mr Jean Rosenfeld	Private Consultant	

WP2.2 Shading devices and diffusing materials

Activities and outcomes

WIS is the only software package of its kind to allow calculations for windows including solar shading devices and light-diffusing materials. There was therefore no precedent classification of such components, nor was a methodology available to define the required properties (as was the case for non-scattering components). Furthermore, there are no standards describing methods of measurement of the optical properties of such components.

The default method used in WIS to calculate the transmittance and reflectance of blinds is based on a **view factor** analysis for the diffuse component in accordance with ISO/FDIS 15099. Although it is very fast, the view factor method assumes that all slat reflections and slat transmissions are diffuse, which can be an incorrect assumption for blinds that are specularly reflecting.
Therefore an alternative and more detailed method, based on **ray tracing**, has been incorporated into WIS primarily to calculate the optical properties of slatted and pleated blinds, although it can also be used for other types of shading devices. The ray tracing method is very precise and includes all inter-reflections between the blinds. The diffuse components of both transmittance and reflectance are assumed to be equal in all directions in the hemisphere.
For blinds that are highly specular the ray-tracing option is a much better choice than the view factor method. This is illustrated in figure 2-wp2.2.1. that shows the reflection of normal incident light of a shading system with blinds under 45 degrees angle. The blinds are assumed to be specularly reflecting. Under these circumstances the layer should have zero reflectance for light at normal incidence and smaller angles, because all incident light that is reflected on the top side of one blind will be reflected at the bottom side of the second blind and transmitted forward. However, the view factor method assumes diffuse reflectance and thus some light will be reflected backwards.

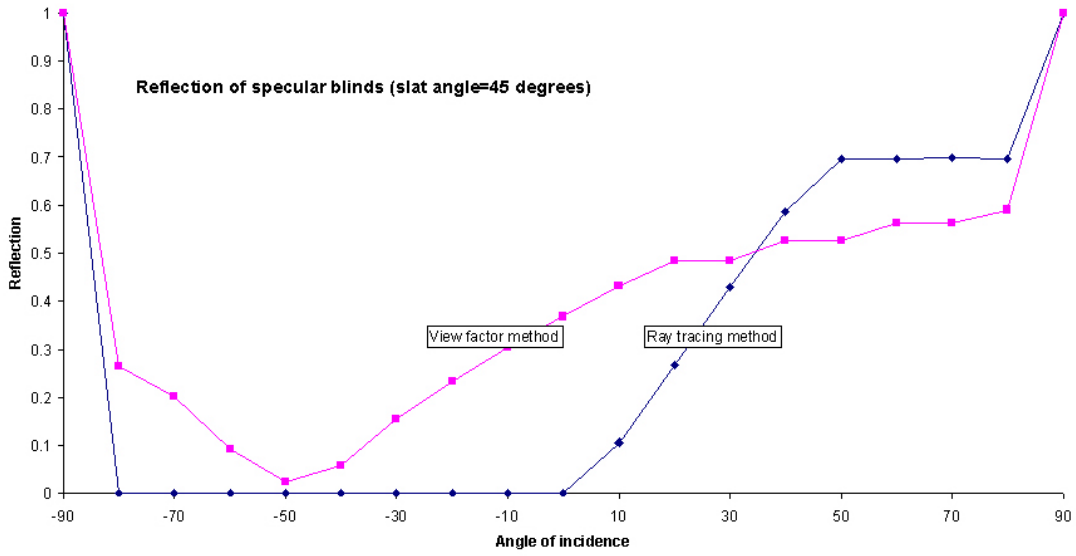


Figure 2-wp2.2.1- Calculated reflection of slat shading system (slat angle 45 degrees, specularly reflecting) with view factor method and ray tracing method).

Members of WP2.2 developed a classification of shading devices and diffusing materials and definitions of their properties needed for calculations to be performed in WIS. They also agreed on recommendations on methods of measurement.
The results are embodied in the Data Submission Procedure for Shading and Diffusing Components [1].

The optical properties that must be given in the data file for the submission of spectral optical properties for shading devices are listed in table 2-wp2.2.1.

Table 2-wp2.2.1: Contents of the spectral data file. Total normal – hemispherical transmittance and reflectance.

Column number	Content	Description	Comments
1	Wavelength	280 (300) – 2500 nm	
2	$Tf_{n, dir}$	Transmittance, front surface Direct	
3	$Tf_{n, diff}$	Transmittance, front surface Diffuse	When equal to zero, it is assumed that the transmittance is regular (all direct).
4	$Tb_{n, dir}$	Reflectance, front surface Direct	
5	$Tb_{n, diff}$	Reflectance, front surface Diffuse	When equal to zero, it is assumed that the transmittance is regular (all direct).
6	$Rf_{n, dir}$	Transmittance, back surface Direct	When equal to zero, it is assumed that the reflectance is diffuse.
7	$Rf_{n, diff}$	Transmittance, back surface Diffuse	
8	$Rb_{n, dir}$	Reflectance, back surface Direct	When equal to zero, it is assumed that the reflectance is diffuse.
9	$Rb_{n, diff}$	Reflectance, back surface Diffuse	

An example of a data file header for the submission of spectral optical properties data for shading devices is shown in figure 2-wp2.2.2.

{Units: Nanometres}
{ Manufacturer: A well known manufacturer }
{ Product name: A new product ® }
{ Reference: www.mycompany.com\products\downloads.htm }
{ Product type: 2 }
{ Position: 7 }
{ Material: Aluminium }
{ Appearance: Blue }
{ Orientation: Horizontal }
{ Thickness: 0.5 }
{ Width: 50 }
{ Crown height: 2 }
{ Pitch: 48 }

{ Conductivity: 100 }
{ Emissivity front: 0.9 }
(Emissivity back: 0.9 }

280	0.100	0.000	0.800	0.710	0.100	0.000	0.805	0.700
285	0.110	0.000	0.805	0.700	0.105	0.000	0.800	0.700
290	0.130	0.100	0.782	0.690	0.130	0.100	0.780	0.690
…								

Figure 2-wp2.2.2. Example of the Header of a WinDat Spectral Optical Properties file for the submission of data on shading devices and defusing materials (Example 1: Curved Venetian blinds, convex surface outwards.) Refer to table 2-wp2.2.2 for description of the last three rows.

WP2.2 also collected information on European manufacturers of shading devices and diffusing components to whom the above document has been sent, inviting manufacturers to submit data for their products to be included in the WIS database [2].

Contributions to Deliverables for WP2.2
D4, Preliminary classification of data: completed.
D8, First set of component data available: several shading devices incorporated into the WIS database.
D16, Internal testing of download of data: completed.
D21, Update classification of data: completed.
D22, Additional sets of data available: Invitations sent out to over 70 European manufacturers to submit data. To date several have responded positively and their data are expected shortly.

Table 2-wp2.2.2: Types of blinds and diffusing components to be used for data submission

ID	• **Type**
1	• Diffusing devices (Roller blinds, screens)
2	• Slat shading devices (Venetian blinds & fixed slat shading devices, louvres)
3	• Pleated blinds
4	• Diffusing panes and diffusing monolithic or laminated components

References

[1] Rosenfeld, J. Data Submission Procedure for Shading and Diffusing Components version 1, WinDat-DTU-2004-04-23, .
WinDat N2.07, April 2004 (**public**)

[2] Rosenfeld, J. Master List of Producers of Windowcovering Products
WinDat N2.08, April 2004 (**confidential**).

WP2.3. Edge seals, frames and windows

Overview of activities and results

In order to make WIS a powerful and flexible tool to determine energy performance of windows there was a need to develop improved methods to calculate thermal properties of frame profiles and edge constructions of the glazing. The data needed in WIS are the thermal transmittance of the frame and the linear thermal transmittance of the edge construction in the assembly of the glazing and frame.

In WP2.3 a data submission procedure of thermal properties of edge constructions and frame profiles have been developed. For calculating the thermal transmittance of the frame profiles and the linear thermal transmittance standard EN ISO 10077-2 [1] must be used. A frame profile made of wood covered with aluminium is shown in figure 2-wp2.3.1

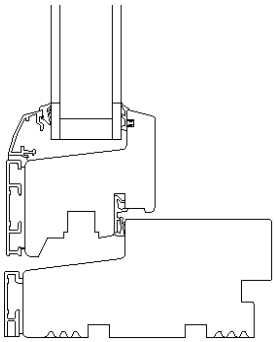


Figure 2-wp2.3.1. Frame of wood covered with aluminium

A method to characterize the thermal properties of edge constructions in a single number called the overall thermal conductance has been developed [2]. The method is based on the so called "Two box model" and refers to the spacer profile and seal that together form the edge construction. An edge construction of aluminium is shown in figure 2-wp2.3.2 and the Two box model is shown in figure 2-wp2.3.3.

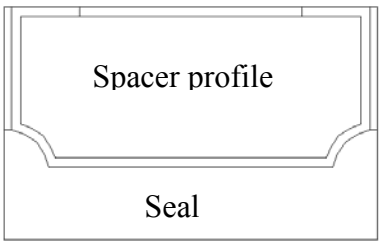


Figure 2-wp2.3.2. Actual edge construction

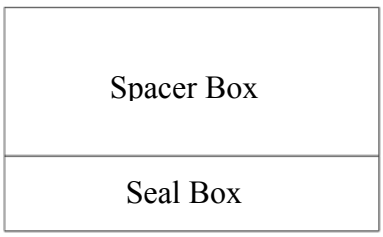


Figure 2-wp2.3.3. Two Box Model

Based on comparison of detailed 2D calculations of the heat flows in the actual edge construction and of the two box model an equivalent thermal conductivity of the spacer box is found. The overall thermal conductance of the edge construction is found from the dimensions and the thermal conductivities of the seal and spacer box.

Furthermore a method to present the linear thermal transmittance as a function of the characteristic thermal properties of the edge construction and the glazing has been developed [4] and [5]. This method makes the window U-value calculations more flexible when combining different glazings edge constructions in specific frame products. The method facilitates easy and precise calculation of linear thermal transmittance, Ψ, for every combination of glazing and edge construction without performing detailed and time consuming 2-d calculations every time. Furthermore the method is very relevant for use of warm edge construction with improved thermal performance.
In figure 2-wp2.3.4 the traditional procedure to determine Ψ is shown together with the new method. Both approaches are based on the European standard EN ISO 10077 –2 [1].

Determination of Ψ–value for a specific frame profile in combination with different edge and glazing products

Frame manufacturer:

Symbol	Method
U_f	Calculation for the specific frame profile
Ψ	Calculation for **each** combination of edge and glazing products
Results	
U_f	U-value of the specific frame profile
Ψ	Table (for the actual frame) with Ψ-values for each combination of edge and glazing products

Window manufacturer/designer:

Symbol	Method
Ψ	Get the actual Ψ-value from table with Ψ–values for each combination of edge and glazing products
U_w	Calculate U-window as weighted mean from U_f, U_g and Ψ

Determination of Ψ–value for a specific frame profile as a function of the U-value of the glazing, U_g, the glass thickness, d, and the overall thermal conductance of the edge construction, L.

Frame manufacturer:

Symbol	Method
U_f	Calculation for the specific frame profile
Ψ	Calculation of Ψ for a few combinations of U-value of the glazing, U_g, the glass thickness, d, and the overall thermal conductance of the edge construction, L, in order to determine Ψ as a function of U_g, L and d
Results	
U_f	U-value of the specific frame profile frame
Ψ	Expression Ψ (U_g, L, d) from which Ψ can be derived directly for every combination of U_g, L, d

Window manufacturer/designer:

Symbol	Method
Ψ	Get the actual Ψ from the expression Ψ(U_g, L, d) for the actual edge and glazing products
U_w	Calculate U-window as weighted mean from U_f, U_g and Ψ

Figure 2-wp2.3.4. Procedures for determination of the linear thermal transmittance Ψ of the edge construction in the assembly of the glazing and frame.

The main benefit of the new method of determining and expressing the Ψ-value is that the window manufacturer does not have to perform 2D calculations for all combinations of edge construction, glass thickness and U-values of glazings but can determine the Ψ-value as a function of those parameters and use that for all glazings and edge constructions.

During the project a large number of product data has been collected from European manufacturers. For edge constructions most of the warm edge products available on the European market is now covered in the new edge construction database in WIS.
For the frame profiles data base some typical profiles have been collected from all the participating countries.

To get an overview of standards and other projects related to Work package 2 a list of links to certification schemes has been worked out in [7]

WP2.3 Contributions to deliverables.

D21. Update classification of data

A detailed procedure of how to determine and document thermal properties of frame profiles, edge constructions and windows has been developed. The procedure for classification of data are described in the sub reports: [2][4][5][6].

D22. Additional sets of data available

A large number of data on frames and edge constructions has been collected for the database.
The database contains data on more than 40 European frame profiles so far [8]. In table 2-wp2.3.3 the types of frames received are listed.
In table 2-wp2.3.4 manufactures of edge constructions who have delivered data are listed. These are typical edge constructions on the European market.

Table 2-wp2.3.3 Frame profiles received from European countries.

Country	Wood	Wood/Alu	Alu	Plastic
Denmark	1	2	1	1
England	5			9
Finland		2		
France			3	4
Germany	2			4
Greece			3	
Italy	1		4	1
Sweden		6		
Switzerland				2

Table 2-wp2.3.4 Edge constructions.

Manufacturer	**Traditional edges**	**Warm edges**
Erbslöh Rolltech a/s	15	5
Lingermann gmbh, Helima	10	9
Swisspacer, Saint Gobain		10
Thermix, Ensinger Gmbh		16
Technoform, Tgi Glass Insulation Systems Gmbh		20
Profilglass S.p.A.	1	

References

[1] CEN (2003):EN ISO 10077-2. October 2003. European Standard. Thermal performance of windows, doors and shutters – calculation of thermal transmittance – Part 2: Numerical method for frames

[2] Laustsen, J. B., Svendsen, S. WinDat WP2.3 Edge seals, Frames and Windows. *Edge constructions and frames.* DTU, Copenhagen September 2003.

[3] Renon, O. WinDat WP2.3. Edge Constructions and Frames, Simplified method for modeling the spacers between glasses in windows. Test cases, CSTB, France July 2003.

[4] Pedersen, F., Laustsen, J. B., Svendsen, S.
A method for characterizing the thermal properties of windows frame profiles.
DTU, Copenhagen
WinDat N2.09, September 2003 (**public**).

[5] Pedersen, F. Solving non-linear data fitting problems using DataFit 8.0. DTU, Copenhagen
WinDat N2.10, March 2004 (**public**).

[6] Laustsen, J. B., Svendsen, S.
WIS Database. Edge Seals, Frames and Windows, Data Submission Procedure for Databases on Spacer Profiles, Edge Constructions and Window Frame Profiles, Version 1.0
DTU, Copenhagen
WinDat N2.11, March 2004 (**public**)

[7] Svendsen, S. WIS Database. Links to Certification Schemes.
DTU, Copenhagen
WinDat N2.13, March 2004 (**public**).

[8] Laustsen, J. B., Svendsen, S.
WIS Database. Status of Database on Spacer Profiles, Edge Constructions and Window Frame Profiles,

DTU, Copenhagen
WinDat N2.12, March 2004 (**confidential**)

2.2.4 Work Package 3, Calculation procedures, link with standardisation and RTD priorities

2.2.4.1 Work programme WP3

Objectives :
To assess the quality of the calculation procedures in the WIS software package, both with respect to the application of CEN standards and with respect to the use of results from recent international research activities. To identify the direction of new common RTD activities for the Network and to propose a strategy for implementation of specific activities.

Description of work/tasks:
Inventory of existing CEN standards for calculating thermal, solar and visual properties of windows and window components (e.g. from CEN TC129: EN 410, EN 673; from CEN TC89: prEN 13363-2, prEN ISO 10077-1, prEN ISO 10077-2; from CEN TC33: TC33/WG1/TG6/N19rev6E, etc.)

Setting up benchmark tests to check whether the WIS software complies with the calculation procedures, in particular as laid down in CEN standards. These benchmark tests will also be available for third parties to check other software tools. The benchmark tests will comprise thermal calculations (U-value), optical calculations (solar and visual transmittance for combination of panes with real or simulated spectral properties) and combinations (e.g. total solar energy transmittance for combination of glazings and/or films and/or shadings).

Investigate the quality of existing advanced calculation procedures in WIS for components and conditions for which no standards exist yet, by comparison with more detailed models (identify problem cases).
Classification of advanced window components (e.g. glazings) with respect to which tools needed.
Suggestions for appropriate inclusion of more advanced glazing types and routines, identify necessity of further research and tool development.

Contacts with representatives in relevant CEN standardisation committees/working groups and international research projects (EU Image, IEA SHC Task 18, Revis, Smartwin-II, Smartwindow, Adopt, Altset, IEA SHC Task 27, etc.).
Discussion of priority needs for future extensions of the software tool.
Stimulation of identification of topics and interested parties for new European RTD proposals.

Deliverables:
A set of benchmark tests
Classification of advanced window components with respect to types of tools needed
Software package validated against CEN procedures
Topics and interested parties for future RTD proposals.

2.2.4.2 Methodology and scientific achievements related to WP3

Work Package leader:

Werner Platzer (Fraunhofer Institute for Solar Energy, D)

General progress:

The activities in WP3 are subdivided into 4 subgroups:

WP3.1: Benchmark (Werner Platzer, FhG-ISE)
WP3.2: Evaluation (Jean Rosenfeld, DTU & Lars Olson, DTI)
WP3.3: Needs of simulation (Paul Strachan, Univ. Strathclyde)
WP3.4: Database management (Thomas Frank, EMPA)

WIS software update:

One major special activity under this WP3 is the preparation of an updated version of the WIS software package.
The change to more recent software environment (MS Windows 3.1 ➔ MS Windows 2000; MS Office97 ➔ MS Office 2000; MS Access Basic ➔ MS Visual Basic) took much more effort than reasonably could have been expected.
This caused a delay in the distribution of the Interim version of WIS.
Microsoft also changed the way to produce a stand-alone tool which is based o MS Access database and user interface. Therefore, the Interim version seems to run only if MS Access 2000 is already installed or together with a "runtime only" (licensed-free) version of MS Access 2000, which then has to be installed together with WIS.

At Mid Term the updating of the package was basically completed (version 2.0) and activities were started to test the tool and to implement other (minor but urgent) changes in the tool.
New features in this **interim update** (**WIS version 2.0b, followed by version 2.0.1, July 2003**) are for instance:

- Recently submitted and reviewed spectral datasets of commercial glazings in the database.
- Routines for ventilation in gaps (e.g. between solar shading and glazing), both for forced and free convection, updated to be in line with the recent ISO DIS 15099.
- Gap to gap free convection allowed.
- Report with detailed information (e.g. surface temperatures) for each angle of incidence of solar radiation.
- New proposal from ICG TC10 on classification of coating existence and types added to the database and applied.
- Iteration procedure improved to minimize the risk of calculation failures.

Version 2.0.1 was made publicly available from the web site. The promotion was kept deliberately modest, because a number of improvements were still needed before the tool should receive a mass promotion.

After the completion of version 2, the efforts to implement further improvements were continued in an intense way.

Version 3.0.1, **the final product of WinDat**, has a high number of new features:

From WIS 3.0.1- Release notes:

New features

- Ray-tracing calculations are possible for both slatted type blinds (such as Venetian blinds and louvers) and for pleated blinds.
- Instead of one shading category (venetian blinds), WIS now included 4 different types of scattering layers:
    - Slatted type blinds (venetian and louvers).
    - Pleated blinds.
    - Roller blinds and screens.
    - Generic diffusing devices (such as diffusing panes and other scattering devices not belonging to one of the other categories).
- In the WinDat project new formats have been defined for spectral pane data and spectral data for scattering devices. Spectral data should now be imported using a separate program that is included in the WIS set-up: The WIS database manager. This program has some other features (like importing data from older WIS databases and other databases) which are described in a separate document.
- The properties of scattering devices are represented in a newly organized way. They are split in general information properties, geometric properties, optical properties and thermal and other properties.
- A spacer database is included in WIS. This database can be used in conjunction with the two-box method.
- The linear thermal transmittance for the combination of frame, spacer and glazing unit can now be determined in three different ways:
    - By using the "characteristic" PSI value of a frame (valid for only one specific combination of frame, spacer and glazing unit. This PSI value must be determined according to ISO 10077-2.
    - By using the standard table from ISO 10077-1 (valid for generic types of frames, glazings and spacers).
    - By using regression data for the frame determined with the two-box method (see WINDAT website for more information about this method). This method allows calculation of the edge effects for every combination of glazing unit, frame and spacer.
- The PSI value is allowed to be zero. This option can be used for curtain walling systems when the U-value of the joints is determined (including all edge effects). Two of such framejoints (example 1 and example 2) are included in the database and an example of the calculation of the total U-value of the curtain walling system is included on the WINDAT website.
- External programs & Calculation settings are accessible through main window.
- The menu has been extended to include new features.
- All data of window components (panes, shadings and scattering layers) carry an extra parameter called groups. This is used to group data together that

belongs together (e.g. measured data fro a specific project). The group filed can be used to look up data or filter data (see filter options).

- All forms are extended to show extra information (groups, supplier, etc).
- An extra option has ben added to print forms or data records.
- Two extra windows are added caled Groups and Suppliers. Through these windows you can access all component data for a specific group or supplier.
- Closing WIS must be confirmed.
- Deleting data must be confirmed before it is actually deleted.
- Changing data must be confirmed before it is actually changed.
- Every form includes options to sort and filter data according to specific criteria, see the WIS help file for details.
- About 170 new panes with spectral data are added to the database.
- About 50 new frames and frame components are added to the database.
- An extra database with a number of spacers has been added.
- The linear thermal transmittance (PSI value) for windows can now be determined with 3 different methods.
- The calculation settings menu now integrates all options related to the way calculations are done (CEN only mode vs. expert mode, which air mass to use, for shadings: use the view factor (radiosity) method or ray-tracing method).
- A window called External Programs has been added. It contains al links to external programs that can be launched from WIS. A few extra links were added. The current links are:
    - Kobra;
    - Therm;
    - Datafit;
    - Autocad program;
    - DBM (Wis Database Manager) for importing spectral data.
- The WIS help file has been updated to reflect the recent changes.
- Some obsolete menu items (giving useless remarks like "future option?") were removed.
- Coating class information has been added to the pane data.
- Spectral pane data that has passed the WinDat peer review is marked with an "E" in the acceptance field.

New data

- A lot of new spectral data has been added for specular glazings and scattering devices. A large number of frames has been added. Furthermore some data has been added for some selected spacers. This data can be used together with the two-box method to determine the U-value for any combination of glazing unit, frame and spacer (when the regression data for the frame is given).

Bug fixes

- In the special case of **spectral** ray-tracing calculations for (systems with) shadings the angle dependant properties of the (system with) shading were reported incorrectly. Calculated data for negative angles was reported at positive angles and calculated data for positive angles was reported at negative angles. This has been fixed.

- In the case of ray-tracing calculations for (systems with) shadings that have a slat angle of 90 degrees (completely closed blinds), WIS reported all zeros for the optical properties of the shading system. This has been fixed.
- Spectral data that was not in nanometers could sometimes not be imported. This has been fixed (data import now through separate program).
- Spectral data that had no leading zeros (.837 instead of 0.837) could not be imported. This has been fixed (data import now through separate program).
- · The detailed environment button showed a form that could not be changed. This option has been removed.
- When a path to an external program was empty or incorrect an error was raised. This has been changed to a warning that the path is not correct.
- When a path to Therm was correct it was still not launched. This has been corrected.
- When a transparent system included non-spectral panes and spectral shadings, the shading properties were incorrectly calculated and thus the transparent system properties were calculated incorrectly. This has been fixed.

Known bugs

- Some pane data cannot be deleted (error message about related data in the frame database).
- Removing the last pane in the database will automatically create a new empty pane.

The WIS co-ordination team:

The development of WIS is co-ordinated by:
TNO - Building and Construction Research
Delft, The Netherlands
Main involved persons:

Responsibility:	Person(s):
WinDat Thematic Network	***Dick van Dijk***
WIS development	***Leo Bakker*** (≤ 2003)
	Luc Soethout
	Richard Versluis (≥ 2003)

Feed back:

All ***members of the Thematic Network WinDat*** actively contributed to the development of WIS, by extensive testing and providing feed back.

Software code:

Specific WinDat members also contributed to the software code itself. In particular ***prof. José Louis Molina, University of Sevilla (Spain)***, who was responsible for the development of the routines describing the optical part of the solar shading devices and its new ray tracing module.

WP3.1: Benchmarks

(a) Overview of activities in this subgroup.

The approach:

Benchmark testing is used to establish a certain performance of a system. For the calculations of window and facade properties within this project we followed three main intentions:

1. It is not within the scope of this network project nor is it the intention to compare benchmark cases calculated with monitored and tested values of real systems. However, the benchmark cases can be used to compare different algorithms, e.g. EN standards with other extended algorithms
2. The benchmark cases will provide users of the WIS software with a means to identify possible misunderstandings and to learn how to correctly transform a real problem into a calculation case. Thus it supports the educational part of the program.
3. Benchmark calculations alone are not sufficient to check the implementations of calculation algorithms. However when using an incorrectly working tool the benchmark cases are likely to produce wrong answers and can give some hints with respect to the problems encountered. In combination with the evaluation exercise of WP3.2 the benchmark cases serve to users and developers good faith in the correct operation of the program.

The activities

Preparation of a number of benchmark cases for three different product areas:
- multiple glazings
- shading devices
– double envelope facades

Provision of typical spectral data for glasses, coatings and materials for the defined benchmark cases

Distribution of benchmark definition document plus a database in the form of an Excel sheet with spectral data to all participants

Preparation of output specification document for easy comparison of participant results

Different groups of participants took part in the calculation exercises related to the three classes of products defined above; the participants were using different tools including WIS 2.0b

Coding of CEN standards EN410 and EN673 in an Excel-Workbook to have an independent means for checking and analyzing the results

Comparison of the participants results on the different benchmark cases

Check of last version of WIS program for the correctness of the benchmark calculations using the CEN-mode (related to EN 410 and EN 673) for glazings only;

as for shading the CEN standard prEN 13363-2, which has been under discussion, had not been implemented as such, because WIS allows a wider range of boundary conditions.

Documentation of the WIS results and of the participant intercomparison exercise

(b) Deliverables

Description of benchmark cases for window and shading performance calculation
In the report a description of 9 different glazing combinations (double and triple glazings) using 14 single glass definitions has been given. Descriptions of 4 different shading devices (external, integrated and internal lamella type blinds plus one textile roller blind) are provided as well.

References:

WP3.1 Description of benchmark cases for window and shading performance calculation. Werner Platzer. Final version January 2003
WinDat N3.01 (public)

Benchmark datasets (excel file)
WinDat N3.01App1 (public)
Deliverables: D9, D23

Output format for intercomparison exercise
The output format has been provided as an Excel sheet in order to harmonize the participants answers.

References:
Output format for benchmark calculations, Werner Platzer, August 2002:
Benchmark results format (Excel file)
WinDat N3.01App2 (public)
Deliverables: D9, D23

Intercomparison of benchmark calculations for glazings and shading device
The report on the intercomparison exercise presents an overview over the intercomparison including the names of the participants as well as tools used. The Excel workbook gives an overview over all participant results plus all individual results for the glazing and shading device calculations

See figure 2-wp3.1 for illustration.

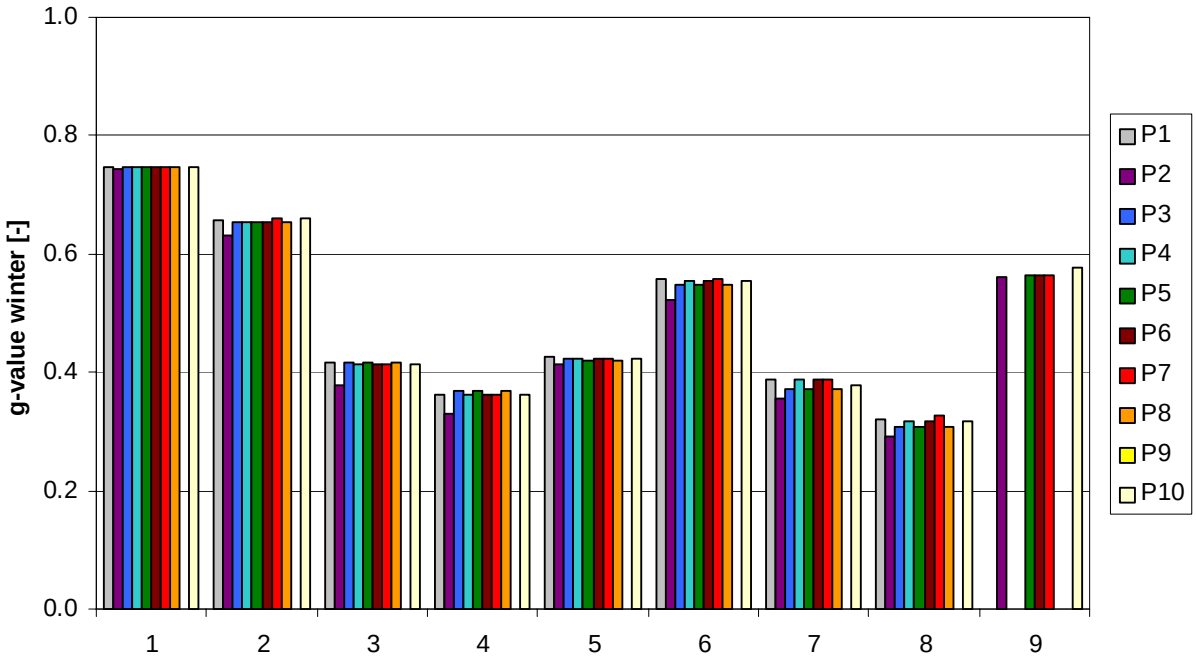


Figure 2-wp3.1. Illustration of benchmark results on glazings: total solar energy transmittance(g-value)<winter conditions> calculated by 10 teams using different tools.

References:
Evaluation of benchmark cases for window and shading performance calculation
Werner Platzer, Final version March 2004
WinDat N3.04 (public)
Benchmark compilation of results (Excel file)
WinDat N3.04App (confidential)

Deliverables: D17, D24

Benchmark calculations for double envelope facades
Double envelope facades are an especially complex facade option.

Therefore a fundamental document was written defining useful quantities for characterisation.
Illustration:
See figure 2-wp3.3:

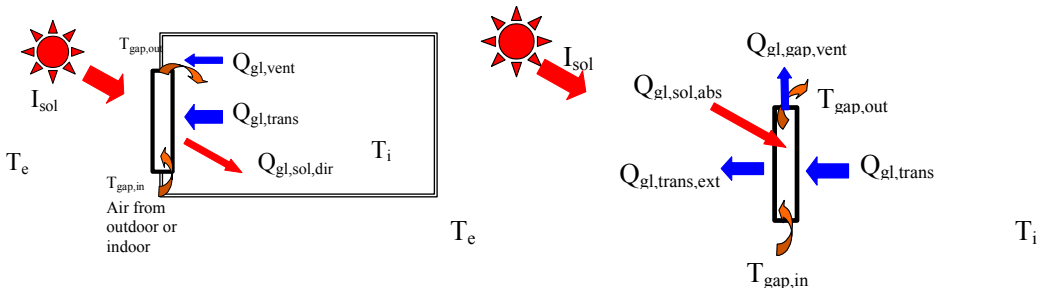


Figure 2-wp3.3: Illustration from the report definitions of quantities for vented windows and facades;
left: quantities related to the effect of the façade on the energy balance of the room; right: quantities related to the energy balance of the window system itself

Link to output from WIS:
The definitions are used to produce in the WIS output the values for each of the energy flows in these two energy balances. Example:

Energy balance of room:

```
--- Split U-value ---

 Uconv                                 :    0.393        [W/m2.K]
 Uir                                   :    0.627        [W/m2.K]
 Uvent                                 :    0.000        [W/m2.K]
                                         ---------------- +
 Utotal                                :     1.02        [W/m2.K]


--- Split solar factor (g) into fractions ---

 solar direct transmittance            :    0.121        [-]
 solar factor convective               :    0.106        [-]
 solar factor thermal radiative ir     :    0.193        [-]
 solar factor ventilation              :    0.000        [-]
                                         ---------------- +
 solar factor (g)                      :    0.420        [-]

--- Split solar gain coefficients to outdoor side into fractions ---

 solar fraction reflected to outdoor   :    0.230        [-]
 solar fraction convected to outdoor   :    0.258        [-]
 solar fraction th. radiated to outdoor :   0.0916        [-]
 solar fraction ventilated to outdoor  :    0.000        [-]
                                         ---------------- +
 solar fraction to outdoor             :    0.580        [-]
```

Energy balance on window:

```
---- Split all 'dark' heat flow coefficients into fractions (h-
values) ---

 h_conv,indoor                         :    0.393        [W/m2.K]
 h_ir,indoor                           :    0.627        [W/m2.K]
 h_conv,outdoor                        :    0.762        [W/m2.K]
 h_ir,outdoor                          :    0.255        [W/m2.K]
 h_vent                                :    0.000        [W/m2.K]
                                         ---------------- +
```

```
 checksum (expected value = h_indoor - h_outdoor - h_vent = 0) :
0.000        [W/m2.K]


--- Split all solar fractions, optical part ---

 solar direct transmittance              :    0.121        [-]
 solar direct reflectance                :    0.230        [-]
 solar absorption fraction layer 1       :    0.227        [-]
 solar absorption fraction layer 2       :    0.000        [-]
 solar absorption fraction layer 3       :    0.149        [-]
 solar absorption fraction layer 4       :    0.000        [-]
 solar absorption fraction layer 5       :    0.250        [-]
 solar absorption fraction layer 6       :    0.000        [-]
 solar absorption fraction layer 7       :   0.0225        [-]

                                           ----------------- +
 checksum (expected value = 1)           :     1.00        [-]

--- Split all solar fractions, thermal part (a-values) ---

 solar absorbed                          :    0.649        [-]
 conv indoor                             :    0.106        [-]
 ir indoor                               :    0.193        [-]
 conv outdoor                            :    0.258        [-]
 ir outdoor                              :   0.0916        [-]
 gap vent                                :    0.000        [-]
                                           ----------------- +
 checksum (abs-others. expected value = 0) : 0.000        [-]
```

Still on the benchmark cases for double skin facades:
A separate document was distributed for definition of geometries and cases.
And a presentation summarizes the results using WIS.

References:

Benchmarks_WINDAT_Double_skin_facades.ppt, Ismo Heimonen
WinDat N3.02 (public) +N3.02App

Definitions of U- and g-value in case of double skin facades or vented windows, Dick van Dijk and Richard Versluis, May 2004
WinDat N3.08 (public)

Deliverables: D9, D17, D23, D24

Validation of WIS software by benchmark calculations
The report compares the CEN-mode calculations of the benchmark cases for glazings and compares that with the results from an independent software where the CEN routines have been coded in a transparent open mode.

References:

Validation of WIS software by benchmark calculations, Werner Platzer, June 2004
WinDat N3.03 (public)

Deliverables: D24

<u>On WP3.2: Evaluation</u>

(b) Overview of activities in this subgroup.

The approach:
The principle approach of this subgroup is to evaluate the algorithms used and to be used in WIS. It has been done by reviewing relevant standards and WIS algorithms in relation to the standards. Validation has been done for a number of algorithms.

The activities

Preparation of a list of CEN-standards relevant for the WIS-calculation and for validation of WIS in relation to the CEN standards.

Prepared inventory of algorithms in the existing WIS software to be checked for CEN standard calculations.

Discussion on evaluation procedures for CEN-standards.

Specific validation exercise for EN 673.

A general validation methodology related to the standards EN 410 and EN 673 has been developed and described in a document. Discussion at the last expert meeting in Brussels.

Preparation of a document on ventilation algorithms in old and new WIS-version.

(b) Deliverables

Evaluation of U-value algorithms in WIS
In the report a validation of the U-values of the glazing in relation to the CEN standard EN 673 was performed. All the parameters influencing the U-value of glazing has been evaluated. This was done with WIS and three different programs all made independent of each other. The results showed agreement between the results showing that WIS provides results in accordance with the standard EN 673.

Reference:

Evaluation of U-value algorithms in WIS. Lars Olsen, Karsten Duer and Ray Williams. May 2004.

WinDat N3.05 (public)

Algorithms in WIS on ventilation in gaps
In the report is presented a description of the ventilation equations used in WIS. First is the equations in the old WIS version described secondly is the equations in the new version presented.
First the equations used in the WIS version 1 are presented. Secondly, the equations which have been implemented in the new WIS version 3.0; these are based on chapter 7 of ISO-DIS 15099.

References:

Algorithms in WIS on ventilation in gaps. Dick van Dijk, Leo Bakker. April 2002.
WinDat N3.07 (public)

Evaluation of program calculation procedures according to standards EN673 and EN410
In the report special evaluation and checking procedures are defined which are directly related to specific algorithms within the standards En 410 and EN 673. Using special input data certain algorithms can be isolated from others and thus be tested more specifically than with a benchmark calculation.
An illustration is given in figure 2-wp3.4.

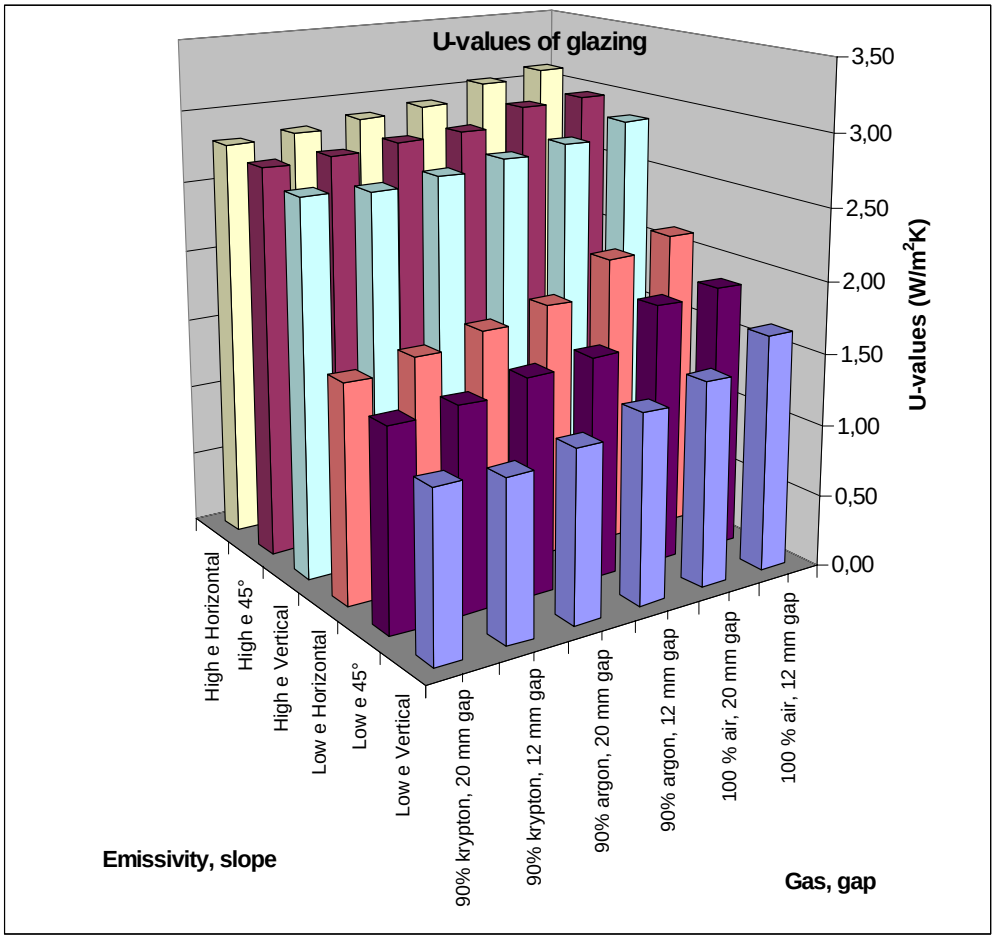


Figure 2-wp3.4: Illustration from U-value evaluation report (U-value of double glazing units)

Reference:

Evaluation of program calculation procedures according to standards EN673 and EN410, Werner Platzer, Final version March 2004
WinDat N3.06 (public)

On WP3.3: Requirements for Thermal and Lighting Simulation Programs

A subgroup in the WinDat project was formed to analyse the needs of simulation programs for glazing data. The main objective of this sub-group was to:

define the requirements for output from WIS for thermal and lighting simulation programs.

The secondary objective was to:

consider the output format from WIS in order to make it easy to import WIS data into thermal and lighting programs.

The following were the participants of the sub-group:

- P Strachan, I Macdonald, J Hand: (ESRU, University of Strathclyde): subgroup leader
- J de Boer: Fraunhofer Institute (ISE)
- M Zinzi: Italian Agency for the New Technologies, Energy and Environment
- R Mitanchey: ENTPE, Lyon
- S Svendsen: Technical University of Denmark
- D van Dijk, P Nijnatten: TNO (TNO Building and Construction Research and TNO Institute of Applied Physics

At the start of the project WIS produced a range of derived information regarding window performance as a result of the calculation procedure. This sub-group was concerned with reviewing these outputs with regard to the current and perceived future requirements of simulation tools.

A review of simulation tools was undertaken to enable their current requirements to be classified (Requirements for Thermal and Lighting Simulation Programs, Hand J W, Macdonald I A and Strachan P A). The subgroup report details these requirements for a range of commonly used detailed simulation programs for both lighting and thermal analysis.

Future requirements were determined by consulting program developers, taking into account the information produced by WIS currently and not used by simulation tools. A number of developments were identified which are likely to be required by simulation programs as they are configured to model increasingly complex glazing systems, e.g. ventilated windows, double facades, glazings and blind systems where bi-directional properties are needed.

In addition, a number of alternative WIS data output formats, which could be imported into thermal and lighting simulation programs, were investigated. XML was selected as the best option, and a draft of the output schema was developed by TNO. Lastly, a detailed suggestion was made by ENTPE for linking WIS with other programs.

Reference:

Requirements for Thermal and Lighting Simulation Programs, Hand J W, Macdonald I A and Strachan P A,
WinDat_N3.09 (public)

<u>On WP3.4: Database management</u>

The database management of WIS was discussed at several meetings. The final result is the database structure of WIS that:

a) enables the import and export of data;
b) enables grouping of data in user defined groups

On WP3 RTD plan

WinDat contributed to the discussion regarding identification of future RTD activities. The input from WinDat partners is reflected in the RTD proposal WISKIT (Dec. 2001) and in the Expression of Interest WinWin for FP6 (June 2002).
A workshop was organised in 2002 at the EPIC conference in Lyon were research items were identified on glazings and active facades.
Also during the project meetings future RTD issues were discussed.
See report on identification of future RTD activities

References:

WinDat Identification of Future Requirements for RTD, Werner Platzer, July 2004
WinDat N3.10 (confidential)

Deliverables: D25

Relation with CEN:
There are many activities in CEN and ISO relevant for WinDat and vice versa.

Specific activities in CEN are delegated from CEN to ISO. Therefore, we refer also to ISO activities.

We mention just a few of the relevant actions from WinDat members in CEN or ISO:

- WinDat members contacted ISO TC163 WG9 in order to prepare a proposal to add the two-box method as additional normative method in the relevant standard (EN ISO 10077-1).
- WinDat members are involved in the CEN TC89 WG7 ad hoc group to investigate the possibilities to adopt ISO 15099 (detailed calculation of thermal and solar properties of windows) as CEN standard. There are a number of serious discrepancies between several standards within ISO itself, and even more with several CEN standards.
- WinDat members commented on draft Product Standard for e.g. U and g-value for windows, because it would not be in line with the needs for energy and comfort calculations.
- WinDat members commented on draft simplified CEN method for curtain walls, because it would not produce conservative values, compared to a detailed numerical calculation method.

2.2.5 Work Package 4, Training and education

2.2.5.1 Details from the work programme

Objectives :
To set up a discussion platform and Frequently Asked Questions for end users of the WIS software package on the Web-site. To develop instructions and examples for the end users of the software and a course module for students to encourage the use of all its capabilities, to stimulate correct use and prevent misuse.

Description of work/tasks:
To prepare structure for discussion platform and Frequently Asked Questions for end users of the WIS software package.
To update existing instructions for the users, either as context sensitive 'helpfile' and/or as 'on line' help at the Web-site.
To collect examples of calculation results which may be instructive for the end users to illustrate the wide possibilities of the software package, to be available on the users platform of the Web-site.
To investigate possibilities for building in messages and warnings to guide the user to stimulate correct use and prevent misuse.
To develop a course module for students of engineering, building physics, etc. to provide a useful teaching tool to familiarize potential future users with the system.

Deliverables:
Discussion platform for the users of the WIS software package.
Updated instructions for the end-users, either as help-file or at the users platform of the Web-site.
Set of examples with explanation for the end users, available at the users platform of the Web-site.
A course module for students of engineering, building physics, etc. as teaching tool on the software.

2.2.5.2 Methodology and scientific achievements related to WP4

Work Package leader:
Thomas Frank (EMPA, CH)

Progress:

Introduction
The software WIS was produced within the previous 5th FRP project 'Advanced Windows Information System (WIS)', 1994-1996, coordinated by TNO.

Since 1996 this version was in use and highly appreciated by many users from different professions. But it lacked mass penetration, mainly due to a fee being asked per license (to cover distribution and support costs) and a poorly populated database containing only a limited number of examples of products.

In 2001 the European Thematic Network WinDat ("Windows as Renewable Energy Sources for Europe - Window Energy Data Network") was started, supported by DG for Energy and Transport of the European Commission, to make the program WIS available with no charge and to build up an European data base of glazing product.
The Networks membership comprises about 40 leading research and educational organisations, industries, consulting engineers and designers, including a strong representation in relevant international standardisation groups. Together, they represent all interested parties in Europe from research through development to manufacture and distribution (see also http://www.windat.org).

The activities of work package 4 "Training and Education" (see Annex 1) were focused on:
- analysis of user experiences from WIS-1, preparation of a web-platform incl. FAQ
- updating the user guide (help file) and preparation of documented input examples
- preparation of training modules for beginners

The following experts worked together in the WP4:

Dick van Dijk, Leo Bakker, Richard Versluis (NL)
Thomas Frank, Thomas Nussbaumer (CH)
Paul Kenny, Patzi Hernmandez (IRL)
Svend Svendsen, Jean Rosenfeld, Niels-Ulrik Kofoed (DK)
Werner Platzer, Erwin Lindauer (D)
Michael Hutchins, Neviana Kilbey, Paul Strachan (UK)
Mikkel Kragh, Paola Iacomussi, Giovanni di Leo (I)
Dick Dolmans (B)
Ismael Rodriguez (S)

User Experience
WIS 1.0
The official WIS version 1.0 was launched in December 1995. Two versions of the WIS software were made, one "building designer" version without the possibility to input new spectral data and one version for "industry and researchers" with full access to all program features. The sales prices were 185 € and 350 €.

Experience with the software WIS Version 1.0 was collected by TNO and UCD and reported and analysed in detail (see document WinDat-TNO-2001-11-30rev1.doc "WIS-1.0 User Experience" Dick van Dijk, Leo Bakker, Paul Kenny).

From the report the following conclusions can be made:
- WIS 1 was namely distributed in Europe and Asia, a smaller group in USA and Canada, where the competition with the LBL software WINDOW 4 is evident.
- The main users are consultants, industry researchers and teachers at universities.
- FAQ were collected at UCD, bug reports were sent directly to TNO
- Compatibility with the CEN standards is a very important issue for the industry
- Researchers like to have access to more sophisticated calculation procedures, even if they are not harmonised yet.
- The glazing data base is poor and should be enhanced.

- The difference between the two WIS versions was not clear for the public.

WIS 2.0

The new WIS 2 program was demonstrated as Beta-versions at the expert meetings in Athens (2002), Dublin and Copenhagen (2003) and Brussels (2004). A comprehensive document with worked out examples of windows was prepared by TNO to show the correct use of the WIS software tool (see document WinDat_N4.02 "WIS User Guide Examples of windows as input for WIS", Dick van Dijk).

In order to get a first feedback from users of the new WIS-2 version 2.0b, a questionnaire has been distributed (WinDat-EMPA-2003-02-10,"Questionaire", see Annex 2) to Universities. The results from the enquiry can be summarised as follows:

- Main applications of the software are windows including shading and double skin facades. CEN standards (EN410 and EN673) are in the main focus to be used for the product declaration or design process.
- The user interface is easily understandable, only minor changes are needed to improve the correct use of the software.
- The help F1 functions are practical, some more information is needed for importing the spectral data and to give explanations of the used conditions of the calculations applied.
- The report and output options are complete.
- Filter-functions to sort the data are of high priority for next improvements.
- The possibility to import/export data is of medium priority for next improvements.

Many of these wishes could be realised in the final version of WIS (v.3.0.1; see WP3).

Frequently Asked Questions

A FAQ platform has been established on the WIS homepage www.windat.org , where detailed information of the software WIS can be found.

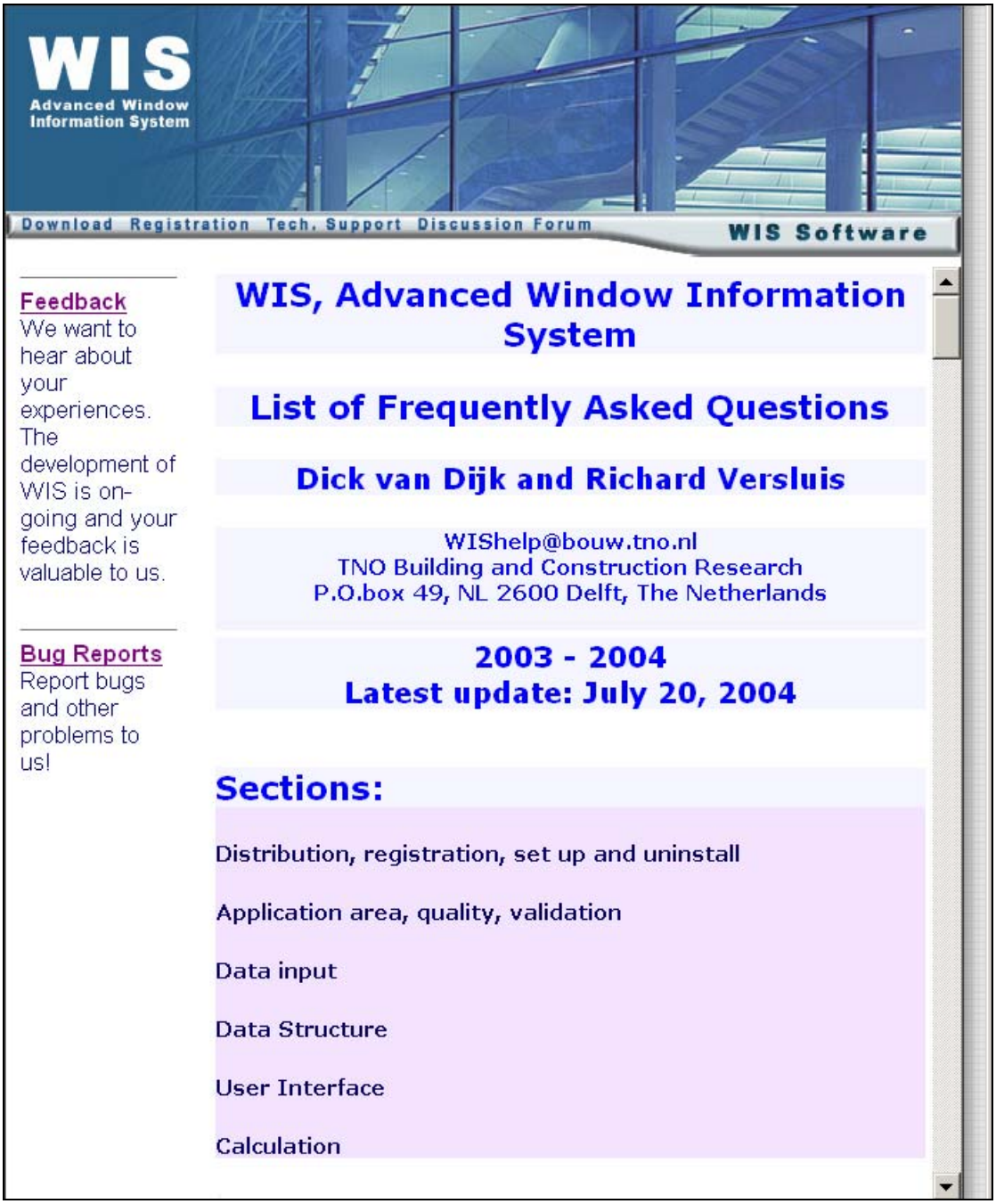


Figure 2-wp4.1: Front page of WIS FAQ list

User Guide

WIS Download Procedure

The document WinDat-TNO-2004-06-22 "WIS Download Procedure", Dick van Dijk, gives detailed background information and advices on the WIS download procedure. The software can be downloaded from the website for free, a registration of the user in order to provide regularly information on new developments of the software.

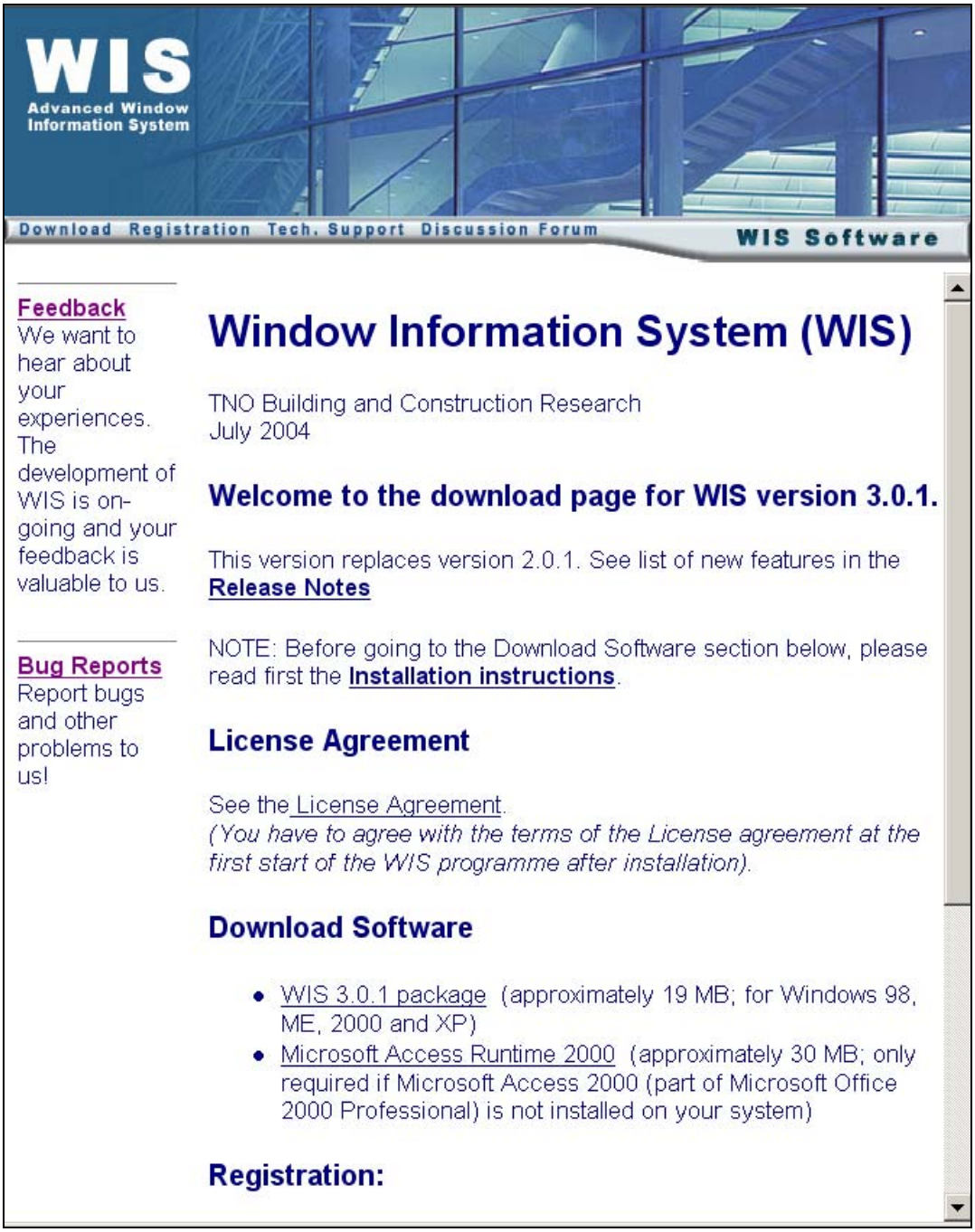


Figure 2-wp4.2: Front page of WIS download page

WIS Help Guide

Together with the software download procedure, different documents, which help to use the software successfully, can be downloaded from the web.

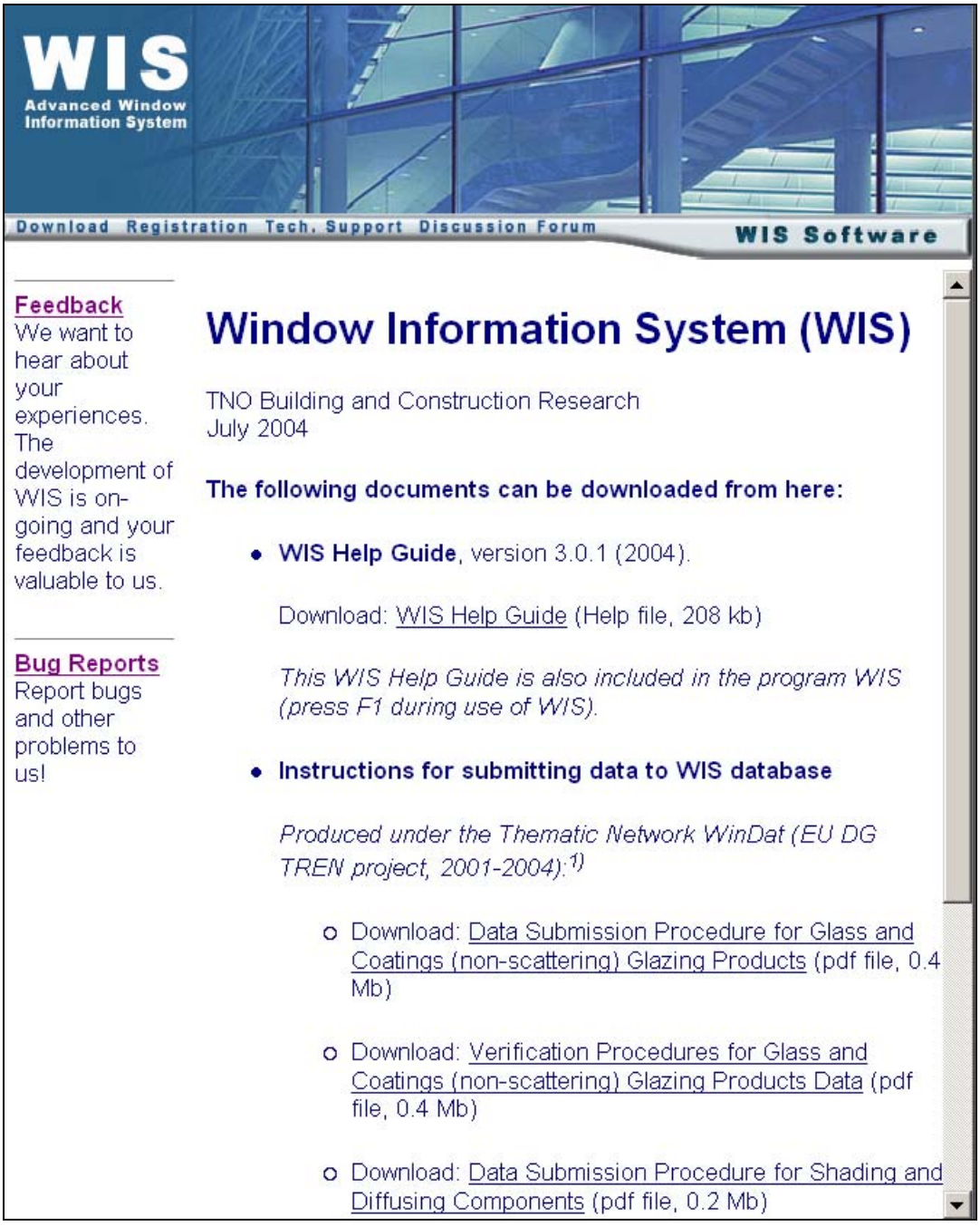


Figure 2-wp4.3: Part of front page of WIS Supporting Documents download page

When running the software WIS, direct help assistance is available via the F1 key. The help functions cover the input forms, the WIS documents and general information on the use of the software.

WIS Help Guide HTML-File

Overview of the content

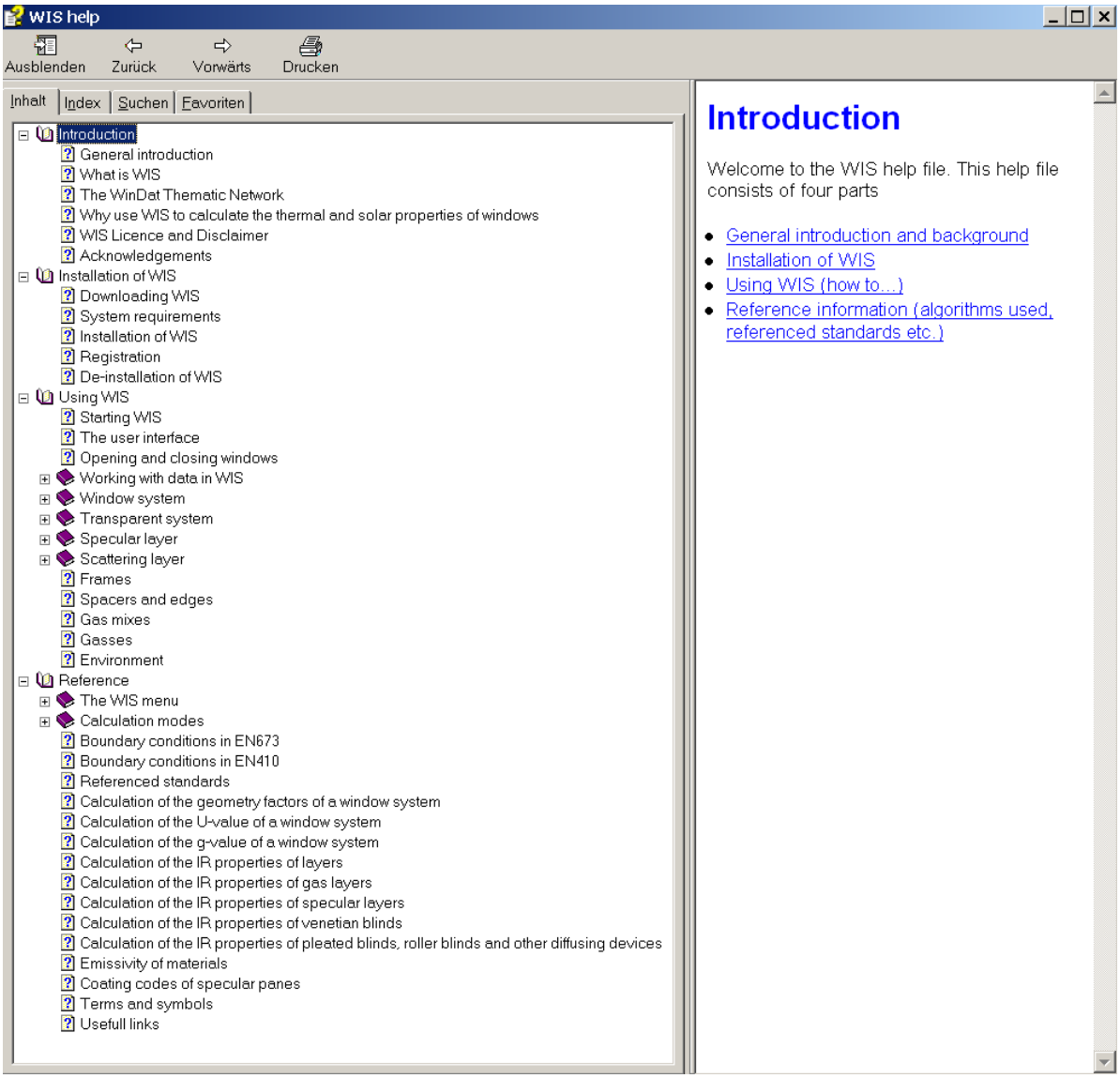


Figure 2-wp4.4: Content page of WIS Help file

Example

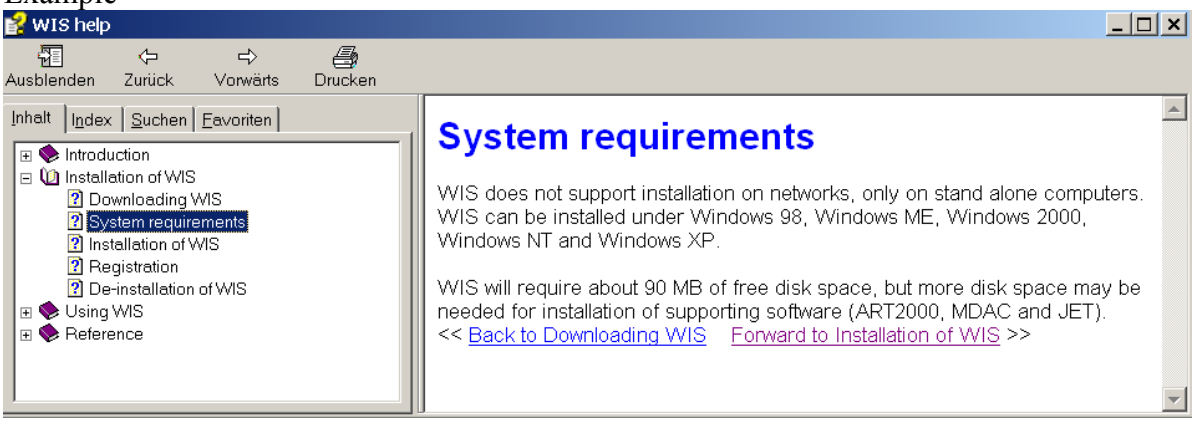
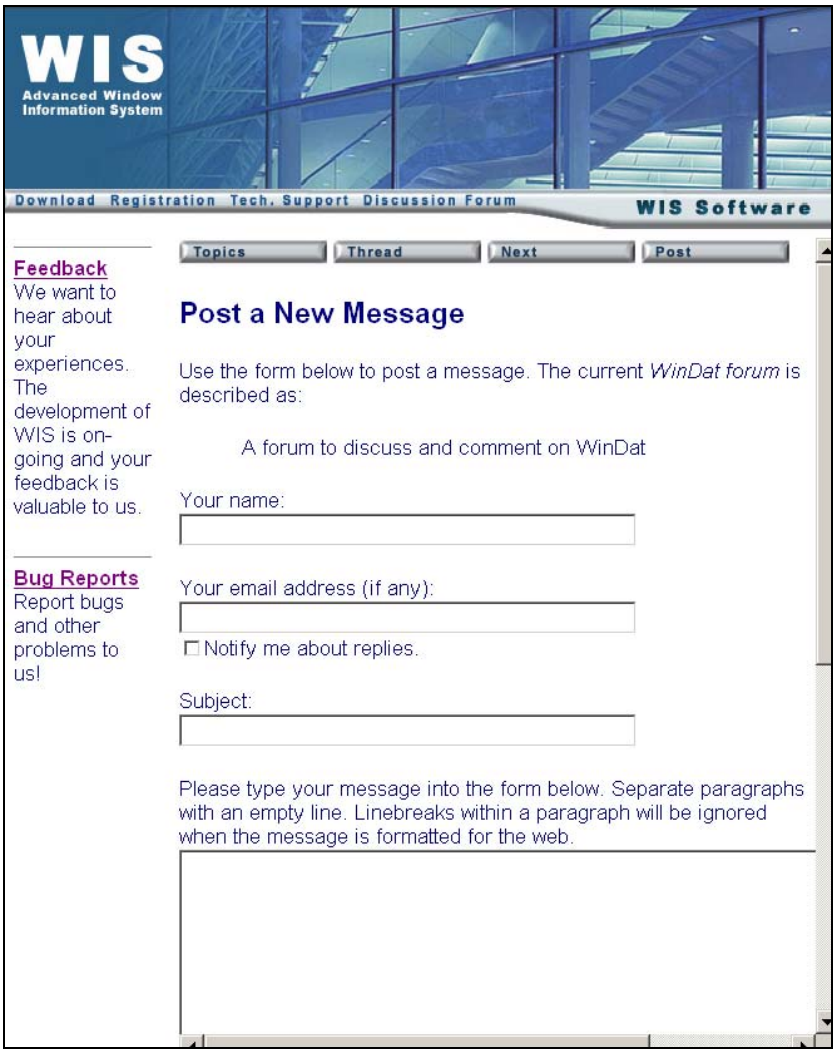


Figure 2-wp4.5: Example from WIS Help

WIS User Forum



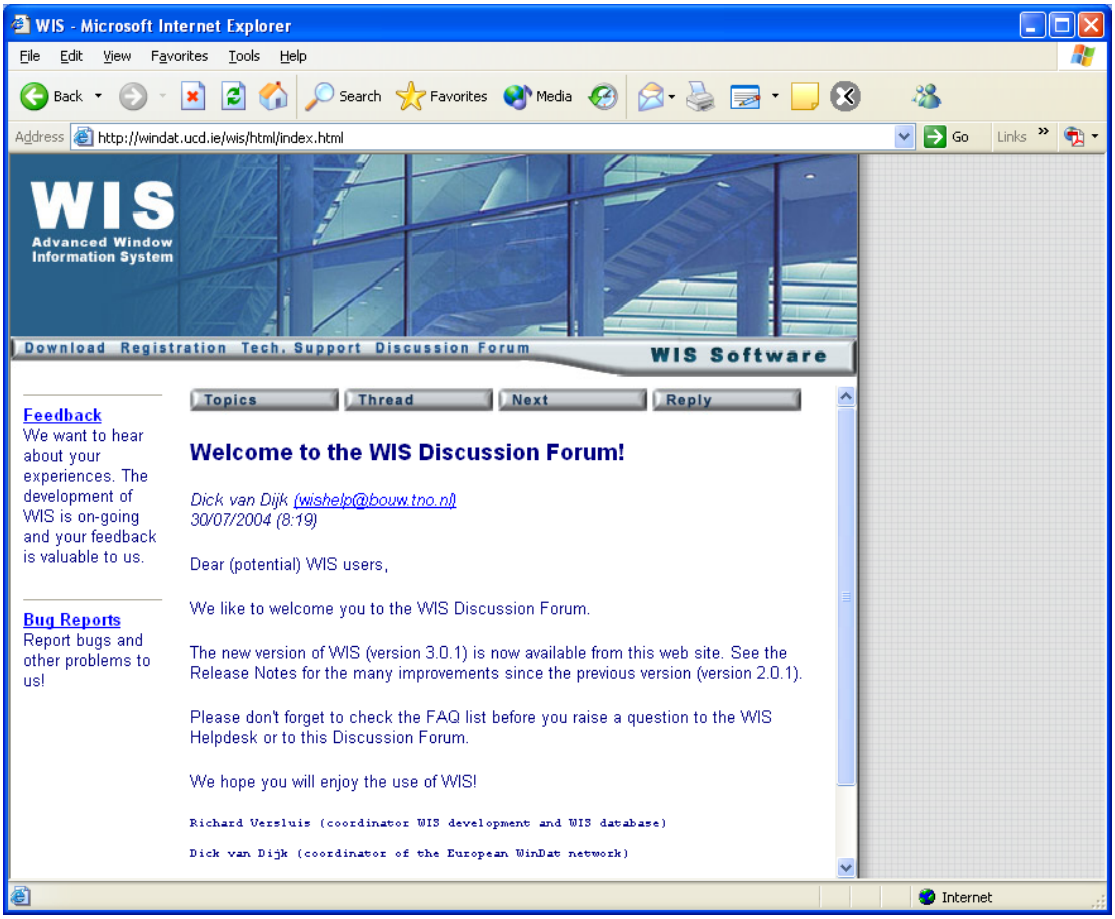


Figure 2-wp4.6: WIS User Forum

Training course

Modules

The training course modules cover the following items:

- 1 Basic physics on thermal and optical properties
- 2 Window components characteristics
- 3 WIS software programme
- 4 Building energy simulation

Basic Physics on thermal and optical properties

This module contains the following items:

- Heat transfer mechanisms (conduction, convection, radiation)
- Thermal and solar properties (U-value, g-value)
- Spectral distribution (ultraviolet, visible, solar, thermal wavelength range)
- Specular and scattering reflecting materials
- Total solar heat gain factor (direct, secondary component)
- Reference to EN standards used

Window Components

This module describes the different components of the windows:

- Panes and screens
- Fields of application (heating or cooling dominated climate)
- Shading devices and other scattering materials
- Frames and spacers

The WIS Program

This module gives an overview of the WIS programme, its main structure, the calculation basis and the data management:

- Introduction
- Calculation modules
- Data management (input/output)
- Example and remarks

Building energy simulation

Building energy simulation tools use window data with different level of complexity:

- Simplified calculation tools (e.g. EN832, EN 13790) use U- and g-values only
- Detailed calculation tools use window system data for each component, layer by layer, for the optical data normally multiband calculations are made. An example of an input data structure of a window is given in Annex 3 for the program TRNSYS.

The hands out for the course are:

- CD with WIS software setup programme and documentation in pdf format
- Print out of all power point presentations
- WIS User Guide “Examples of windows as input for WIS”

The **powerpoint presentations** are stored as separate **confidential** appendices to this document.
The confidentiality is intended to stimulate attendance at the training course sessions.

Annex 2 Questionnaire on WIS-Software Version 2.0b

Range of Application

1a) For what kind of calculation problems are you using WIS?

.....

1b) Do you need only the european standardized procedures (EN 673, EN 410) or also the unrestricted methods?

.....

User Interface

2a) Do you feel the comprehensibility of the user interfaces (Gas, Gas_mix;Pane, Shading, Frame, Transparent System, Environment, Window System) are easy understandable?

.....

2b) If not, which user interface could be improved and what should be made more clear?

.....

2c) Do you feel the user interfaces are self-explanatory?

.....

Help-Functions

3) Do you feel that there are sufficient help-functions integrated in WIS?

.....

4a) Where would you appreciate to have more help informations?

.....

4b) What special help information would you need? (please mention the window-title where the help is needed)

.....

Data Structure

5a) Are the existing report and output options complete according to your opinion?

.....

5b) If not, what information do you miss in the different report and output options?

.....

5c) Have you any suggestions to improve the clarity of the output reports?

.....

Data Input

6a) Are the existing data import functions easy to use?

.....

6b) What kind of improvements (concerning data import functions) would you appreciate?

.....

Data Import / Export

7a) Do you need an import / export function to exchange data with other users?

.....

Calculation

8a) Is the given information on the used calculation algorithms sufficient for your purpose?

.....

.....

.....

8b) If not, about which topic would you prefer to have more information, and specifically which one?

.....

.....

.....

Data exchange with other programs

9a) Do you have any needs to exchange data-files of WIS with other programs?

.....

9b) To what programs would you like to have a possibility to easy exchange data-files?

.....

.....

Priorities for Improvements

10) What is your assessment of the following improvements? (high; medium; low)

- Improve database content clarity (for example of glazings) ☐ ☐ ☐
- Install filter-functions for panes and glazings ☐ ☐ ☐
- Install filter-functions for panes and glazings ☐ ☐ ☐
- Import / export of data ☐ ☐ ☐
- Install delete-function for datasets ☐ ☐ ☐
- Remove unnecessary ID-Numbers (for example of pane ID) ☐ ☐ ☐

Annex 3 Example of Data File Structure

Example for TRNSYS (**Multi Band Calculation)**

```
Unit System : SI
Name        : TRNSYS 14.2 WINDOW LIB
Desc        : Waermeschutzglas, 0.7, Krypton
Window ID   : 4001
Tilt        : 90.0
Glazings    : 3
Frame       : 11                    2.270
Spacer      :  1 Class1               2.330  -0.010   0.138
Total Height: 1219.2 mm
Total Width :  914.4 mm
Glass Height: 1079.5 mm
Glass Width :  774.7 mm
Mullion     : None
Gap         Thick   Cond  dCond    Vis   dVis   Dens   dDens     Pr     dPr
1 Krypton     8.0 0.00860  2.800  2.280  7.500  3.740 -0.0137  0.660 0.00002
2 Krypton     8.0 0.00860  2.800  2.280  7.500  3.740 -0.0137  0.660 0.00002
3               0      0      0      0      0      0      0      0      0
4               0      0      0      0      0      0      0      0      0
5               0      0      0      0      0      0      0      0      0
Angle     0    10    20    30    40    50    60    70    80    90 Hemis
Tsol  0.268 0.270 0.263 0.253 0.243 0.223 0.183 0.116 0.042 0.000 0.207
Abs1  0.327 0.330 0.339 0.345 0.347 0.351 0.367 0.380 0.313 0.001 0.347
Abs2  0.066 0.066 0.067 0.068 0.070 0.071 0.070 0.064 0.051 0.000 0.067
Abs3  0.108 0.110 0.112 0.113 0.110 0.107 0.101 0.082 0.041 0.000 0.100
Abs4      0     0     0     0     0     0     0     0     0     0     0
Abs5      0     0     0     0     0     0     0     0     0     0     0
Abs6      0     0     0     0     0     0     0     0     0     0     0
Rfsol 0.231 0.223 0.220 0.221 0.230 0.247 0.279 0.357 0.554 0.999 0.269
Rbsol 0.231 0.223 0.220 0.221 0.230 0.247 0.279 0.357 0.554 0.999 0.269
Tvis  0.625 0.632 0.615 0.595 0.570 0.523 0.425 0.265 0.097 0.000 0.484
Rfvis 0.137 0.125 0.121 0.125 0.142 0.172 0.226 0.336 0.554 0.999 0.199
Rbvis 0.137 0.125 0.121 0.125 0.142 0.172 0.226 0.336 0.554 0.999 0.199
SHGC  0.407 0.412 0.406 0.398 0.387 0.365 0.319 0.233 0.112 0.000 0.341
SC: 0.39

Layer ID#         9059F    9052     9060        0        0        0
Tir             0.000    0.000    0.000        0        0        0
Emis F          0.840    0.840    0.070        0        0        0
Emis B          0.070    0.840    0.840        0        0        0
Thickness(mm)     4.0      4.0      4.0        0        0        0
Cond(W/m2-C     )225.0    225.0    225.0        0        0        0
Spectral File     None     None     None     None     None     None

Overall and Center of Glass Ig U-values (W/m2-C)
Outdoor Temperature                -17.8 C      15.6 C      26.7 C      37.8 C
Solar      WdSpd  hcout hrout  hin
(W/m2)     (m/s)     (W/m2-C)
  0        0.00  12.25  3.20  7.17  0.63 0.63  0.65 0.65  0.67 0.67  0.69 0.69
  0        6.71  25.47  3.19  7.18  0.64 0.64  0.66 0.66  0.68 0.68  0.71 0.71
 783       0.00  12.25  3.55  8.29  0.72 0.72  0.74 0.74  0.77 0.77  0.79 0.79
 783       6.71  25.47  3.38  8.21  0.74 0.74  0.75 0.75  0.77 0.77  0.79 0.79
```

2.2.6 Work Package 5, Exploitation and dissemination

2.2.6.1 Details from the work programme

Objectives :
To prepare and organise the free-of-charge distribution of the WIS software package for wide use in Europe, in design, research, industry, standardisation and education. To make a plan for longer term continuity.

Description of work/tasks:
To make the WIS software free-of-charge via registration on the Web-site (incl. disclaimer, etc.) and making the software downloadable for registered users from the Web-site.
To investigate the request for and the activities and associated costs needed for possible translation of the software in other languages.
Investigate most efficient ways and what sources needed to keep component data up to date in longer future.
Collaboration with other countries with similar activities (e.g. USA).

Deliverables:
Software package to calculate thermal and solar properties of windows according to CEN standards plus options for more advanced calculations.
Web-site with free registration and downloading of the software.
Europe wide promotion and distribution among end users (manufacturers, researchers, education, consulting engineers, designers).
Plan for longer term future.

2.2.6.2 Methodology and scientific achievements related to WP5

Work Package leader:

Paul Kenny (per October 2002: Vivienne Brophy and Patxi Hernandez; University College Dublin, IRL)

Progress:

Introduction
This document briefly describes the activities and results that have been performed under WP5 during the course of the project.
Collaboration from all partners was required in some stages, including a questionnaire for exploitation and dissemination and press releases translation and distribution tasks.

Web site
The web site is operational from the early stage of the project, and provides interested third parties basic information on the project.

A new and more powerful server for the web site was installed on 2003 to deal with the demanding features of the website. The operating system used in the new server was changed to Linux. The web site was then optimized for registration and free downloading of the software.

The set up of download includes registration with unique Idcode to start WIS as "registered user". Also: license agreement, disclaimer and detailed installation instructions.

Another features of the website include WIS FAQ list, Public documents downloadable (Help Guide, User guide, Data Submission Procedures), User Forum.

Figure 2-wp5.1: WinDat website main page

Complete information:
WinDat N5.01 (confidential)

Evaluation of the software distribution and promotion process
The software distribution via the website gradually led to a critical mass of users, which provided a valuable testing community for following releases.

At the end of the project, about 200 users of different backgrounds have been registered via the website, and the statistics show an average of 620 visits per month for the last year (July 2003-June 2004).

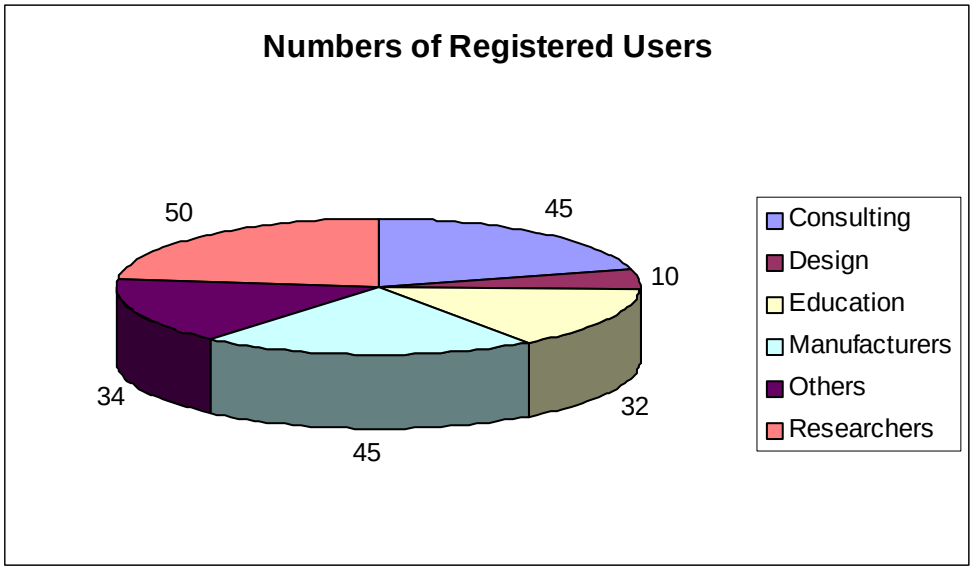


Figure 2-wp5.2. Numbers of registered users of different backgrounds.

For the promotion of the software, apart from the website, it is decided to prepare **press releases (N5.04)** to be distributed across Europe. Two versions for the press releases are prepared in English, a short description of the software, and a more detailed technical article. These press releases are translated to most European languages, including some of countries that are not represented in WINDAT, and some newly associated states. The distribution of the press releases is achieved with the collaboration of all partners, with the help of a database with representative journals compiled by UCD and updated by partners in the different countries.

The **annex** in document **N5.04** lists the persons/organisations responsible for translations and national distribution.

The translations and distribution is planned for May-September 2004.

Complete information in:

Evaluation of software distribution and promotion,
WinDat N5.02 (confidential)

WIS Press Reelases,
WinDat N5.04 (public)

Plan for longer term future
Discussion about a long-term strategy for development and support of the software has been carried on thorough the project, with special significant input in the latest partners meetings.

There is a strong wish from members for keeping the group alive, and maintain the WinDat brand name, as it is now well known which has revealed strong and well known, as website statistics show. TNO offers to continue management,

A number of activities that have to be followed on after the project is finished to maintain a minimum operational level for the software were identified, and partners agreed to perform the necessary activities without financial support for a short-term after the project is finished, giving the network some time to find sources of finance.

For another activities like upgrading/developing/promoting the software, additional sources of funding are suggested.

Reference:
Complete information in:

Plan for Longer Term Future of WinDat,
WinDat N5.03 (confidential)

2.3 Assessment of Results and Conclusions

Application-related criteria should be used to assess and measure the output results.

The main objectives of the thematic network were to bring together key representatives from research, industry, standardisation, education and design to remove existing barriers: to make the WIS software freely available from Internet, to set up benchmark tests, to stimulate the population of the program's database with commercial products and research data and to set up a internet based user forum with technical support.

WinDat clearly achieved these goals. The new version of the WIS software, the component data, submission procedures, documentation, course material and support is available at the WinDat web site.

The end products developed in the course of the network will therefore stimulate the understanding and application of European standards in the field and stimulate further standardisation of methods to assess the performance of window and façade components and assemblies.

This gained extra importance by the recent publication of the European Directive on Energy Performance of Buildings (EPBD) that requires that each Member State implements energy performance regulations for buildings before 2006 and by the associated mandate from the European Commission to CEN to develop a set of calculation methods to facilitate the Member States in this respect.

Innovative windows in the sense of energy saving and increasing comfort will lead to better social, economic and ecological working and living conditions, but also contribute to the competitiveness of the involved companies.

2.4 Acknowledgements

The project to set up the Thematic Network WinDat (2001-2004) was financially supported by the European Commission Directorate General for Energy and Transport.
The end products of WinDat were produced with active contribution by all members of this European Thematic Network, coordinated by the leaders of the Work Packages and Subgroups.

See www.windat.org for more information.

2.5 References

The end products of WinDat are consolidated into a number of formal documents, clustered per Work Package.
See list in section 2.2.1.