

International Workshop on NATURAL AND LOW-COST MATERIALS IN WIND ENERGY TECHNOLOGIES

November 10-12 2008, Dhulikhel, Nepal

Report

Purpose:

In developing countries, large parts of population are scattered over scarcely populated rural areas, with long distances between small villages and low energy consumption in villages. In such situation, the traditional technologies of energy supply, e.g. grid extension, become inpracticable. Instead, the decentralised renewable energy sources appears to be the most appropriate solution for energy needs of developing countries and their poor rural and remote regions. Small wind turbines represent a good, economically viable and environmental friendly solution to provide remote villages with light and electricity.

However, the development of renewable energy systems in poor countries should not lead to the situation when the dependency of the country on external energy, fuel supply or transportation is replaced by a new dependency, on expensive materials and equipment, very special maintenance know-how and development aid (necessary to acquire and maintain expensive energy systems).

In order to ensure the energy self-reliance and independence, the renewable energy systems for developing countries should be inexpensive in production and in service, reliable and durable, and productible locally, from local materials and with the use of the local equipment.

The costs of wind turbines can be reduced, and the wind energy technology can be made more attractive for developing countries, if the natural, locally available materials, notably wood, are used to produce parts of the wind turbines instead of or along with conventional composite materials.

The problems of the low cost wind energy technologies, challenges and achievements in this area have been discussed at the International Workshop on "Natural and low-cost materials in wind energy technologies" which took place in Dhulikhel, Nepal.

Project:

The Workshop has been organized in the framework of the Danish-Nepalese collaborative research project “Development of wind energy technologies in Nepal on the basis of natural materials”, which is funded by the Royal Danish Ministry of Foreign Affairs. The project includes three partners: Risø.DTU, company Kathmandu Alternative Power and Energy Ltd. (KAPEG) and the NGO (non-governmental organization) Practical Action Nepal. The project seeks to explore technological possibilities of the electrification of Nepal on the basis of using wind turbines made from locally available, low cost wood materials.

The Organizing Committee of the workshop included representatives of the partner organizations of the project (Risø.DTU, KAPEG and PA Nepal). Povl Brøndsted, Head of Programme, and Dorte Juul Jensen, Head of Department (AFM) were Members of Organizing Committee of this workshop from Risø.DTU.

Leon Mishnaevsky, Senior Scientist at AFM, Risø, and the Project Leader, was Chairman of the Workshop (see Opening Speech, Figure 1).

Lectures and Participation:

Lecturers from USA, Germany, Denmark, United Kingdom, Australia, Sri Lanka, India, Kenya made their presentations on different aspects of small wind energy, materials for wind turbines, prediction of strength and reliability of wind turbines etc.

Totally, about 70 lecturers, guests and students participated at the Workshop. Many students of Kathmandu University and other Nepali universities applied for participation at this Workshop. In order to choose the most qualified students, the Organizing Committee offered the student applicants to prepare essays on the reasons of their interest to wind energy, and perspectives of wind energy in Nepal. In cases, when students prepared good essays but were unable to cover the registration fee of the Workshop, they could apply for waiving the registration fee, and for some basic financial support to attend the Workshop.

The Workshop concentrated on several main aspects of low cost wind turbines:

- scenarios, opportunity and challenges for small wind energy in developing countries;
- timber as a most promising material for blades (as well as more general materials science and strength aspects of wind turbines);
- design, reliability and strength of small wind turbines.

Keynote Lectures were delivered by Professor David Wood (Australia) and Povl Brøndsted (Risø.DTU). David Wood introduced the participants into the principle of the design of small wind turbines, the optimal choice of constructions and materials, as well as experience of the Aerogenesis company with development of low cost SWT.

Povl Brøndsted described the materials science aspects and strength of wind turbines, testing procedures for different wind turbine materials, as well as methods of modelling and prediction of the turbine strength.

In the Sessions devoted to the Experience with Wind Energy in Developing Countries, Mike Harries, Chairman of Bob Harries Engineering Ltd (Kenya) gave an Invited Lecture. He described his company experience with developing a windpump Kijito suitable for manufacture in the developing world. Mike presented the history of the development of the Kijito windpump in Kenya. (Figure 8).

The case studies, scenarios of development and perspectives of the wind energy in developing countries around the world were discussed in the presentations by Professor Jagadeesh (Head of the Centre for Energy and Sustainable Resources, Tamil Nadu, India), Mr. N. Musafar (Sri Lanka), Mr. R. Shreshta (Nepal), Mr. B. Berges (Denmark), Professor P. Freere (Australia). It was concluded that the reliability and low costs of turbines, on the one side, and paying attention to the social aspects and direct influence on the life quality of local population, are crucial factors for the further development of wind energy in developing and poor countries.

Given that the timber is considered as a most promising material for the small turbine blades, a special session devoted to the mechanics, micromechanics and strength of timber to be used in wind turbine construction, was organized. The Invited lecture was delivered by Dr. Ingo Burgert from Max-Planck-Institute of Colloids and Interfaces, Germany (Figure 10). Dr. Burgert reviewed the current knowledge on the structure and mechanical design of wood cell walls with a specific emphasis on interactions of cellulose fibrils and matrix polymers, and discussed parameters of wood selection with regard to potential applications in the field of wind power stations. Further in this session, Mr. Rakesh Sinha (Kathmandu Alternative Power and Energy Group, KAPEG) and Dr. Hai Qing (Risø.DTU) presented their results on the fracture and fatigue testing of wood, and micromechanical modelling of wood (Figure 9). Mr. Sinha and Dr. Qing presented the combined experimental-theoretical approach to the optimal choice of timber for wind blades, developed in the framework of the Danida project. Dr. Povl Brøndsted (Risø.DTU) reported on his recent studies of bamboo wind turbines.

In the Session on the Design of Small Wind Turbines, Dr. Phil Clausen (Australia) presented the method for the designing small wind turbines using the IEC simple load model, Professor A. Balueva (USA) made a presentation on the analytical methods of diagnostics of small cracks in woods for rotating parts (Figure 14). The design aspects of composite blades for wind turbine, based on the delamination analysis, were presented by Dr. H. Hadavinia (Kingston University, United Kingdom) (Figure 16). He discussed various test methods for characterising different modes of composite delamination.

After the sessions, the participants were invited to visit the KAPEG office (Figure 13) and, another day, to see the site of wooden wind turbine in Dhulikhel.

Conclusions:

The participants of the workshop came to the conclusion that the development of small, low cost wind turbines for developing countries is a very important subject both for economies of developing countries, poverty reduction and for the environment policy. The

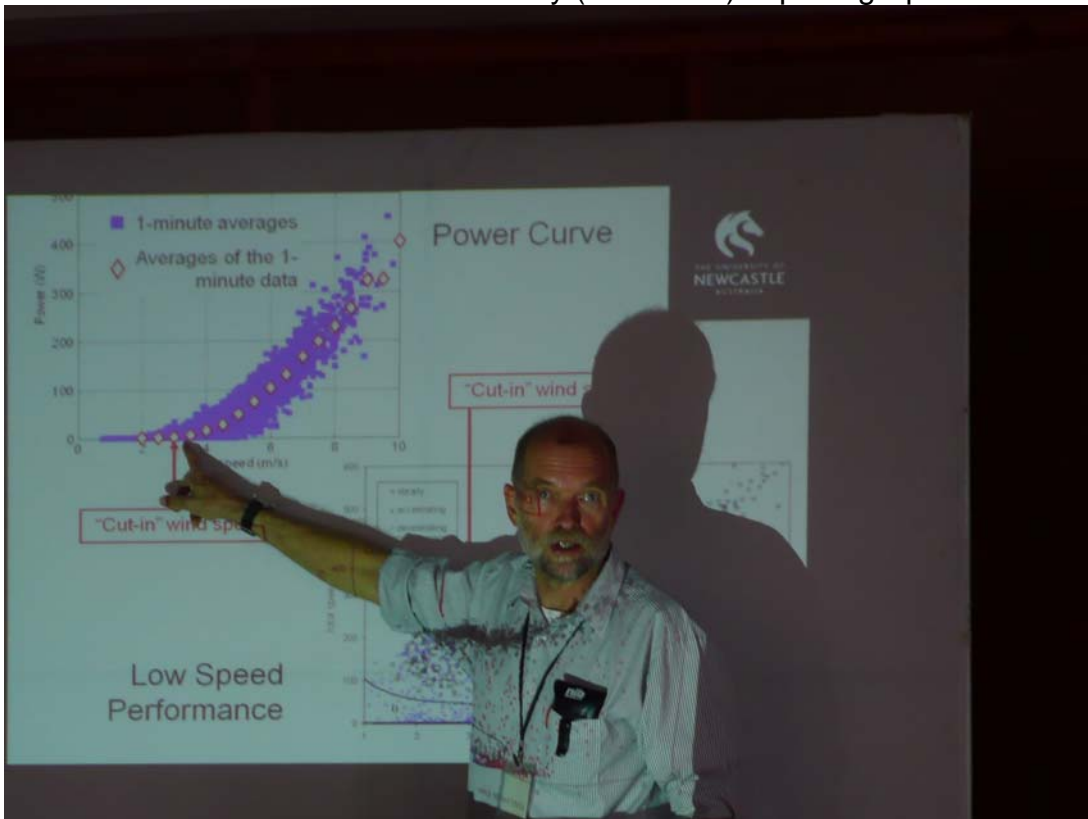
optimal choice of the materials for small wind turbines as well as the optimal blade design and easily productible turbine constructions remain subjects of future investigations. The interesting opportunities for the development of small low cost wind turbines are provided by using timber, bamboo, laminated wood or combinations of composite and wooden materials.

The selected papers, presented at the Workshop will be published as a special issue of the Journal of Wind Engineering.

Photographs:



1. Leon Mishnaevsky (Risø.DTU): Opening Speech



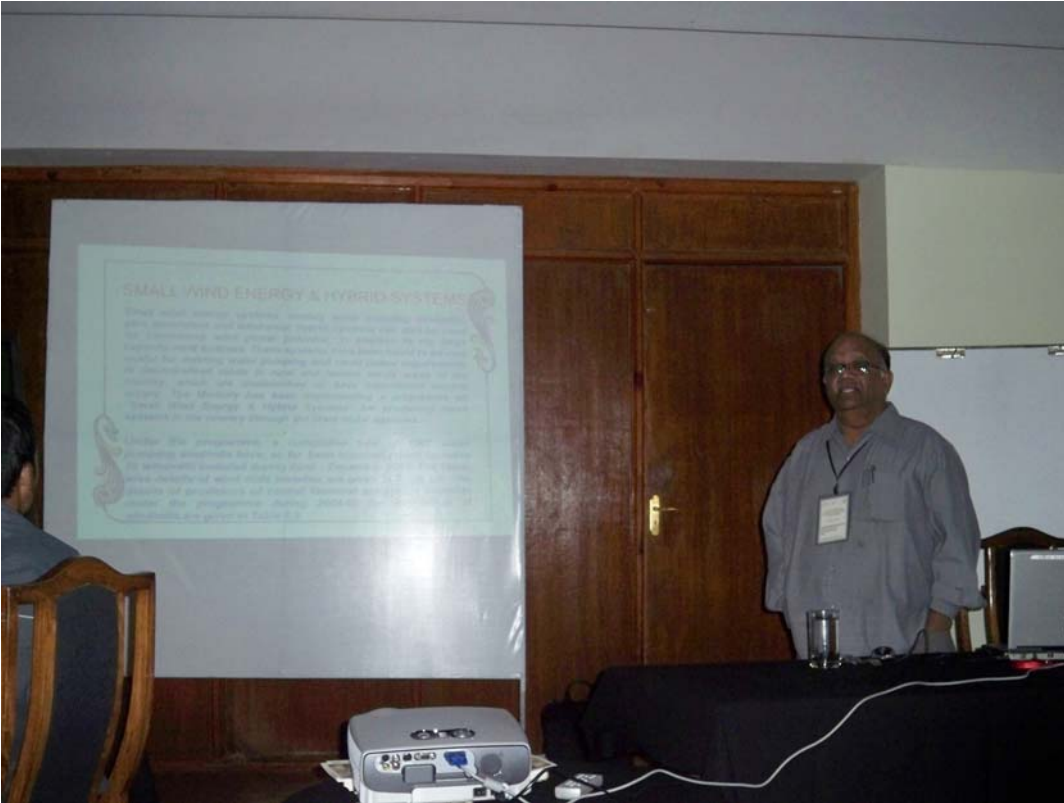
2. Professor David Wood (University of Newcastle, Australia): Keynote Lecture on Low cost small wind turbines



3. Povl Brøndsted (Risø.DTU): Keynote Lecture on Materials challenges in Wind energy.



4. Dr. Phil Clausen (Head Discipline of Mechanical Engineering, The University of Newcastle, Australia): Invited Lecture on designing small wind turbines using a simple load model



5. Professor A.Jagadeesh, Head of the Centre for Energy and Sustainable Resources, Tamil Nadu, India: Invited Lecture on Wind energy development in India



6. Guests and students attend a session. On the background: the Workshop banner.



7. Dinner during the conference. Right side: Dr. H. Hadavinia, UK. Left side: M. Harries (Chairman BHEL, Kenya), Dr. H. Qing (Risø.DTU), Leon Mishnaevsky (Risø.DTU), R. Shreshta (Practical Action Nepal), Ingo Burgert (Max Planck, Germany), A. Balueba (USA), P. Freere (Monash, Australia).

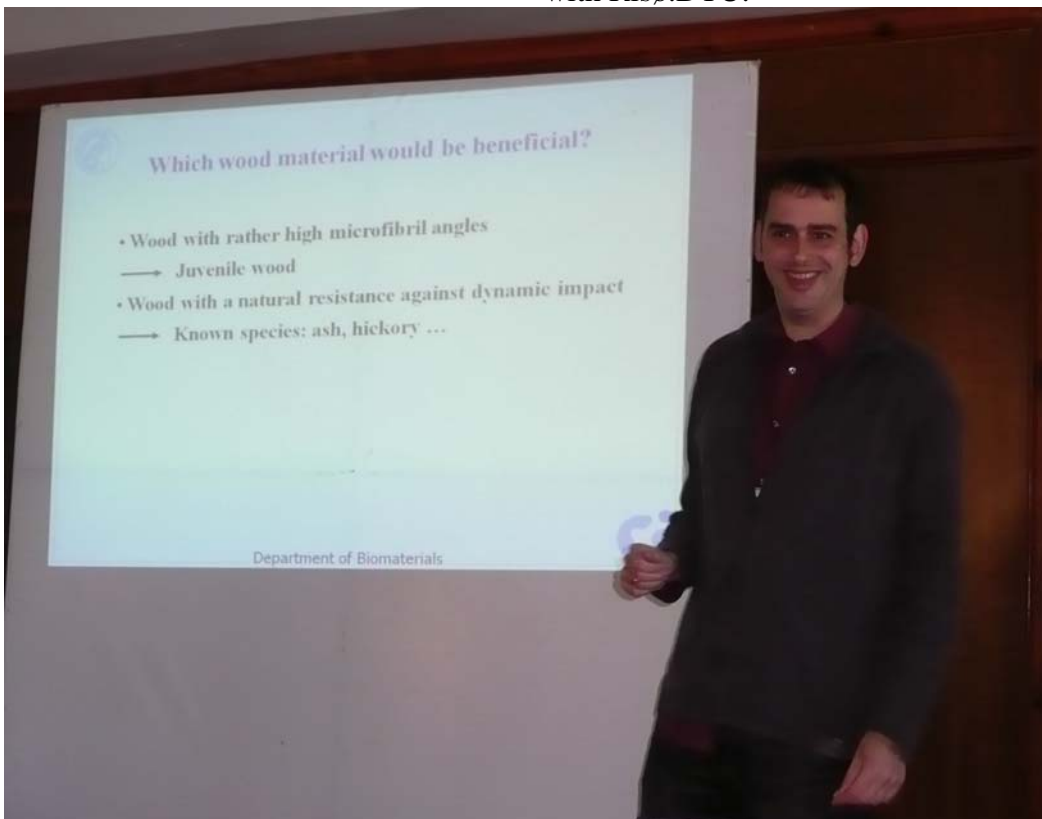


8. Mike Harries, Chairman of Bob Harries Engineering Ltd (Kenya). BHEL subsidized and developed a windpump Kijito suitable for manufacture in the developing world. Mike

presents the history of the development of the Kijito windpump in Kenya.



9. Rakesh Sinha, Senior Research Officer at KAPEG (Kathmandu Alternative Power and Energy Group) presents a experimental investigations of different sorts of timber to be used for wooden wind turbines. The experimental investigations were carried out in collaboration with Risø.DTU.



10. Dr. Ingo Burgert from Max-Planck-Institute of Colloids and Interfaces, Germany, delivers a lecture on “What makes wood stiff and tough?”



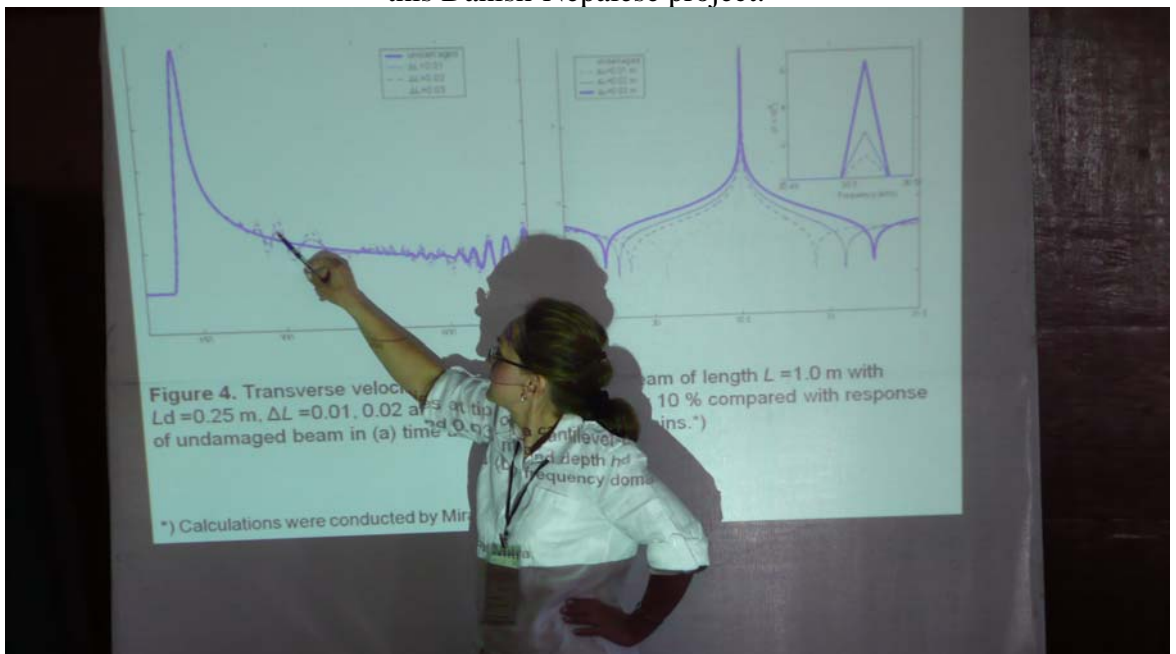
11. Professor Peter Freere, Monash University, Australia delivers a lecture on starting technical business in Nepal



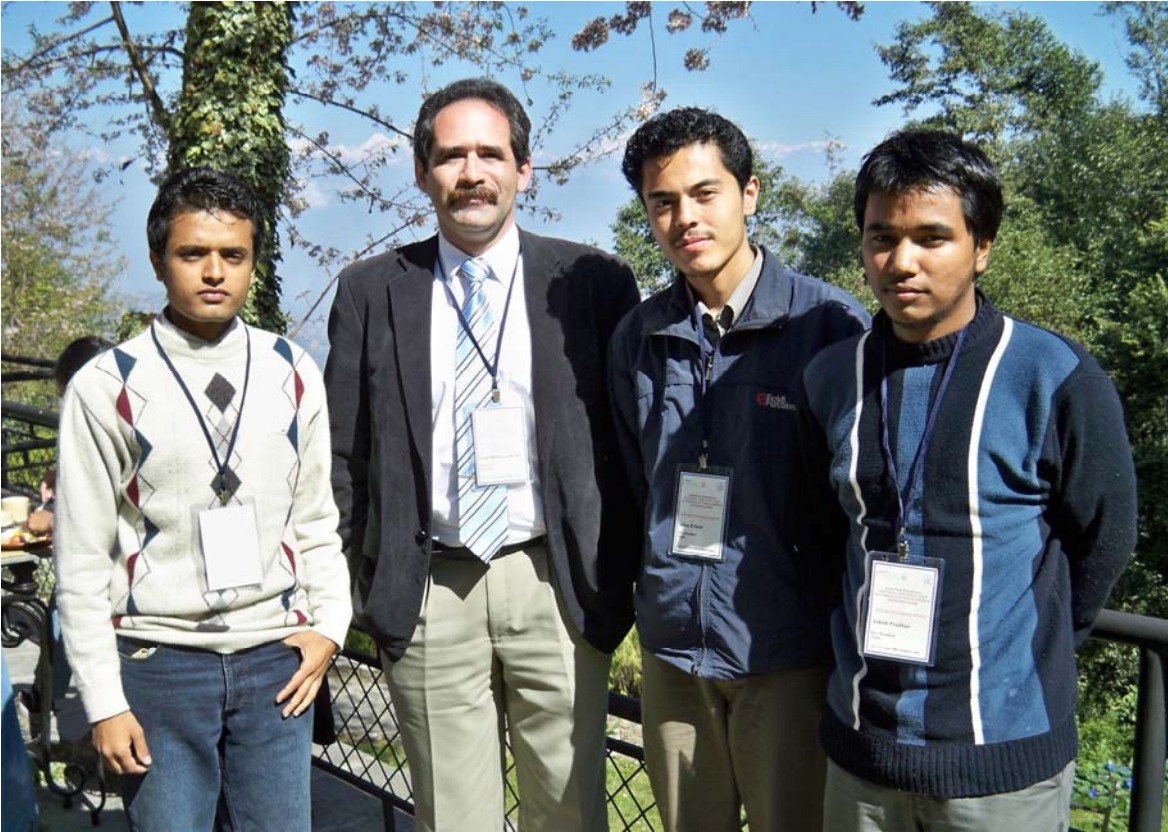
12. Guests, attending a session: (from left to right): Professor H.W. Zhou (China University of Mining and Technology, Beijing), Dr. H. Qing (Risø.DTU), Dr. Paul Peterson (Aerogenesis, Australia), Dr. Phil Claussen (University of Newcastle, Australia).



13. Group visit to the site of KAPEG, Dhulikhel: Sr. Research Officer Rakesh Sinha shows to the guests the testing facilities, available at KAPEG. A number of testing equipment was designed and installed at KAPEG, and partially bought and delivered in the framework of this Danish-Nepalese project.



14. Professor A. V. Balueva, Gainesville State College, Georgia, USA, delivers a lecture on diagnostics of small cracks in woods for rotating parts



15. Coffee pause: Leon Mishnaevsky with a group of Nepalese students (from Kathmandu University).



16. Dr. H. Hadavinia, Senior Lecturer, Kingston University, UK delivers a lecture on design aspects of composite blades for small wind turbines.



17. Group photo of all the participants of the Workshop.

Links:

- Workshop Webpage http://risoe-staged.risoe.dk/Conferences/Nepal_workshop2008.aspx.
- Programme and Abstracts: http://risoe-staged.risoe.dk/Conferences/Nepal_workshop2008/programme.aspx