# MODERN ECOLOGY FRIENDLY PNEUMATIC STRUCTURES

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***Key words:*** *Wind turbines, Urban environment, Greenhouses, Geothermal installations, Pneumatic structures.*

***Abstract:*** *Ecology friendly high power wind turbines have a common axis with the main building structure. Vibration of wind turbines can be extinguished using light nanomaterials for the wind turbine rotor. It rests on bearings insulated with rubber pads of the primary concrete structure of the building. Membrane of greenhouse warming geothermal installation ends with a wind turbine, powered by a warm air rising over greenhouse. Air turbine mounted on the automobile, Pneumatic camper, Avalanche rescue kit and Gas protective shields are presented in the report.*

# СЪВРЕМЕННИ ЕКОЛОГИЧНИ ПНЕВМАТИЧНИ КОНСТРУКЦИИ

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***Ключови думи:*** *Вятърни турбини, Градска среда, Оранжерии, Геотермални инсталации, Пневматични конструкции.*

***Резюме:*** *Екологичните вятърни турбини са с голяма мощност ако имат обща ос с основната конструкция на сградата. Вибрациите на вятърните турбини може да бъдат погасени чрез използване на съвременни наноматериали за ротора на вятърните турбини. Ротора лагерува върху лагери, изолирани с гумени подложки върху основната бетонна конструкция на сградата. Разглежда се освен това мембранна конструкция на оранжерия над геотермална инсталация. Тази мембранна конструкция се отоплява с парникови газове. Конструкцията завършва с вятърна турбина, задвижвана от топлия въздух, издигащ се над оранжерията. В доклада е представена въздушна турбина, монтирана на ходовата ос автомобил. Представени са още: Пневматичен кемпер, Спасителния комплект при попадане в движещи се лавини и Защитни газови щитове.*

**1. Introduction.** The dynamic behaviour of the common mechanical structures can model by the theory, presented in the dissertation [1]. The dynamics of the wind turbine structures could be represented by the following matrix differential equation (dynamical equilibrium conditions):

$$(1) \qquad \begin{bmatrix} M_{yy} & M_{yx} \\ M_{xy} & M_{xx} \end{bmatrix} \begin{Bmatrix} \ddot{Y} \\ \ddot{X} \end{Bmatrix} + \begin{bmatrix} C_{yy} & C_{yx} \\ C_{xy} & C_{xx} \end{bmatrix} \begin{Bmatrix} \dot{Y} \\ \dot{X} \end{Bmatrix} + \begin{bmatrix} K_{yy} & K_{yx} \\ K_{xy} & K_{xx} \end{bmatrix} \begin{Bmatrix} Y \\ X \end{Bmatrix} = \begin{Bmatrix} 0 \\ R \end{Bmatrix}$$

where Y represents a block in the vector of displacements (unknown displacements of the structure), X represents a block in the vector displacements (known displacements of the supports of the structure in case of cinematic displacements like earthquake loadings or wind loadings) and R represents a block

in the vector of dynamic reactions of the external influences (unknown dynamic reactions). Blocking of the matrices in equation (a) corresponds to the blocking of the displacement vector $\left\{\frac{Y}{X}\right\}$.

The boundary conditions of the problem are as follows:

$$(2) \qquad \{\ddot{X}\} = \{\ddot{X}\}_B;\ \{\dot{X}\} = \{\dot{X}\}_B;\ \{X\} = \{X\}_B$$

Here the symbol "B" in the equation (b) means that the corresponding blocks $\ddot{X},\ \dot{X}, X$ are defined on the boundary. This boundary presents by the supports of the structure. The initial conditions of the problem are homogeneous:

$$(3) \qquad Y_0 = Y(0) = 0; X_0 = X(0) = 0;\ \dot{Y}_0 = \dot{Y}(0);\ \dot{X}_0 = \dot{X}(0);$$

**2. Exposition.** In this chapter some ecology friendly high power wind turbines operating in the urban environment, air turbine mounted on the automobile and some other engineering structures are described [1].

**2.1. High power wind turbine.** In the Fig. 1 is presented the scheme of high power wind turbine. It is applicable to operating in urban environments. High power of the wind turbine is determined by balancing the generator axis and the axis of the building structure. Generator stator is mounted on a main building structure. It is made of heavy materials. Rotor package is placed in the parapet of the main building structure. It is made of light materials. This combination of materials isolated the high frequency component of the spectrum of the vibrations. Low-frequency part of the spectrum of the vibration is isolated by rubber isolators used in railway transport. The effectiveness of the presented high power wind generator depends on coupling of the building and the turbines axes. Detail of rotor package is presented in the Fig. 3.

**2.2. Membrane wind turbine of greenhouse.** The other wind turbine structure is presented on the Fig. 2. The structure of greenhouse consists of membrane part and geo thermal installation under it, shown on the figure. This is the structure with continuous operating wind generator. The hot air under the green house structure rises and drives the turbine. The membrane is supported by a ring with helium or light metal central column. Position A represents a geothermal heat exchanger. Position B represents a triple serpentine drilling. The use of system A or B provides geothermal water with a temperature 13 degrees. The heat pump 2 increases the water temperature to working values. In case of areas with water with hot geothermal temperature the heat pump may be missing from the scheme 2. Such areas are in south-western Bulgaria. The presented scheme further provides heat for the greenhouse and electricity from the wind turbine. This is a scheme and ongoing turbine.

**2.3. Air turbines mounted on the automobile.** Another scheme of the continuous operating turbine is represented in the Fig. 4. Through small nozzles of the car is supplied airflow. These small nozzles do not create a large air resistance. Jet spinning rotor turbine made of lightweight material.

Presented three designs show three examples of effective use of wind to produce electricity.

There are many other schemes of efficient airflow. In buildings heating creates low heat flows, which also can be used to produce electricity.

**2.4. Pneumatic camper.** In Fig. 5 a pneumatic camper scheme is presented. When traveling the structure is folded into the trailer of the vehicle. When camping, the pneumatic design is pumped to the compressor of the vehicle. The proposed pneumatic camper design provides at least 50 % energy savings (fuel or electricity) in travel mode, providing a comfortable stay in campsite mode.

**2.5. Avalanche rescue kit.** Principle scheme of avalanche rescue kit is presented in the Fig. 6. In the high mountains often fall avalanches. They pose a serious danger to skiers, snowboarders and hikers.

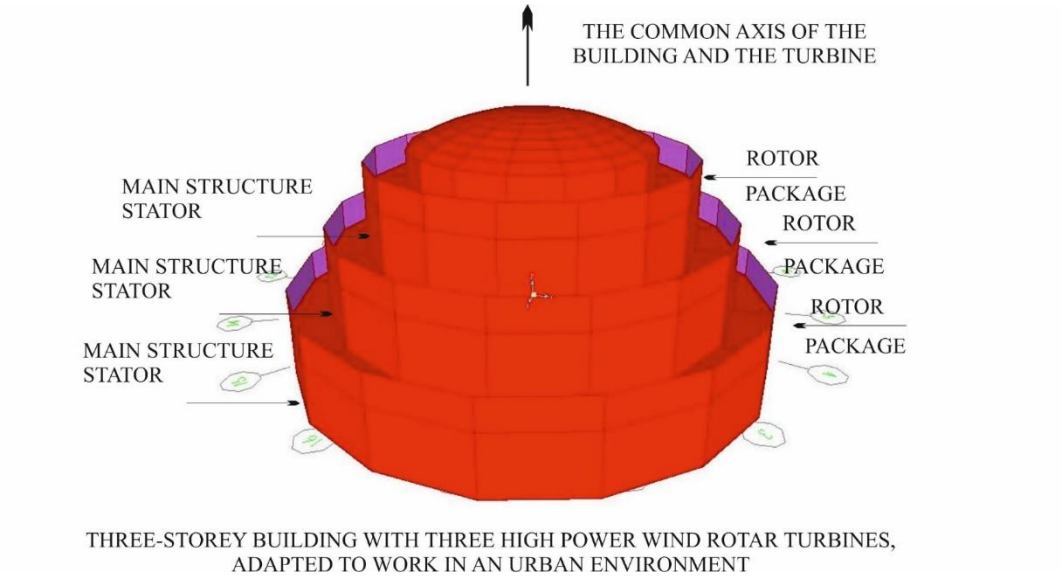


Fig. 1. Connection (alignment) of the building axes and axes of the turbines

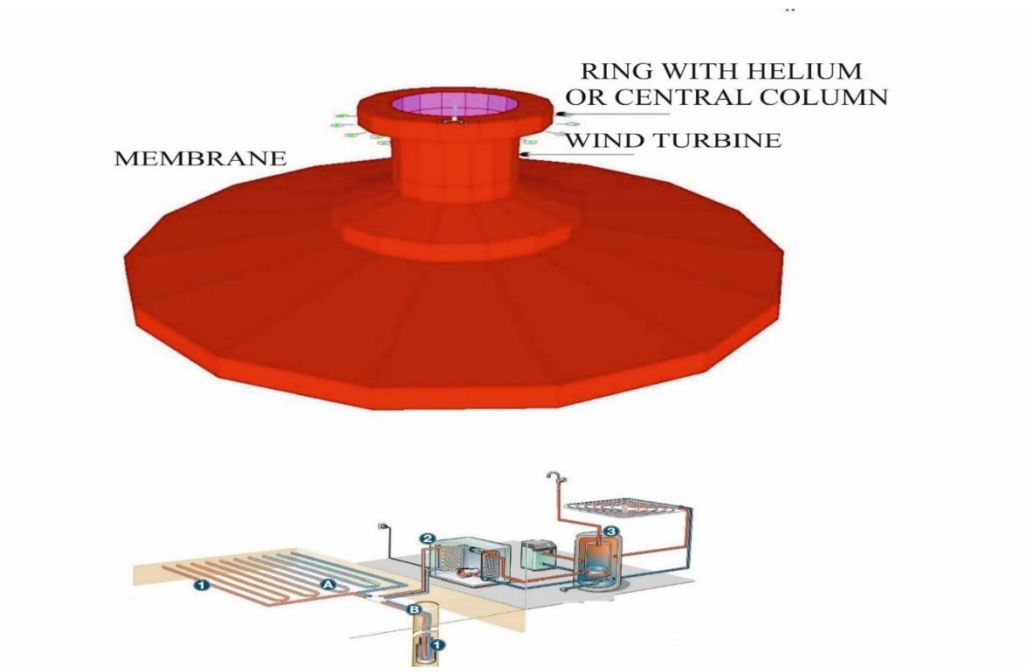


Fig. 2. Green house membrane over the geothermal installation

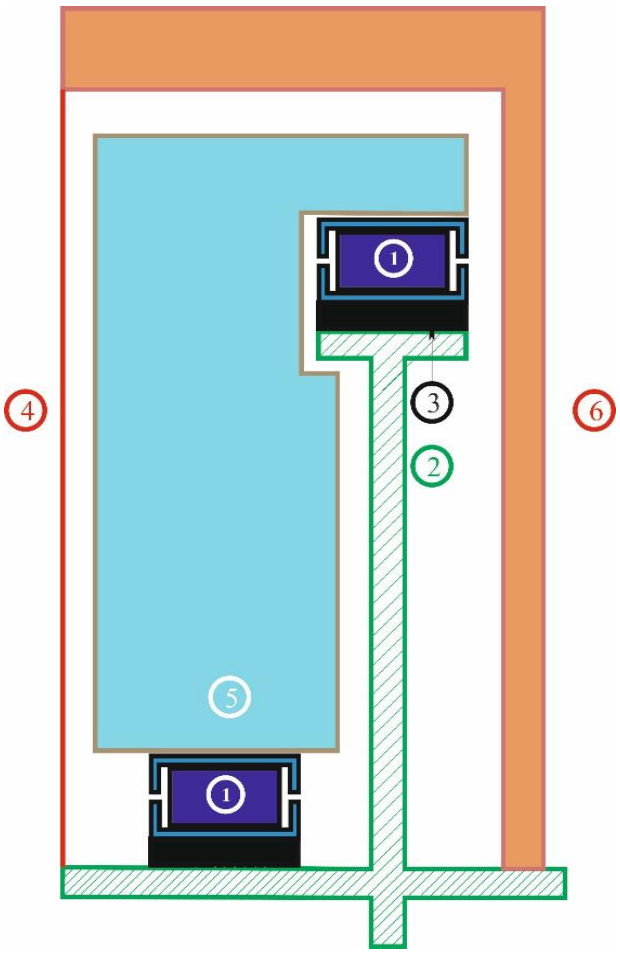


Fig. 3. Detail of rotor package: 1 - Roller bearing diameter of the building; 2 - Roof reinforce concrete plate; 3 - Rubber insulator applied in railway; 4 - Thick steel mesh; 5 - Working plane of the rotor; 6 - Internal housing railing.


Fig. 4. Air turbine mounted on the automobile. The electrical part of the generators is not presented in the details. They can be mounted over the working plane of the rotors.

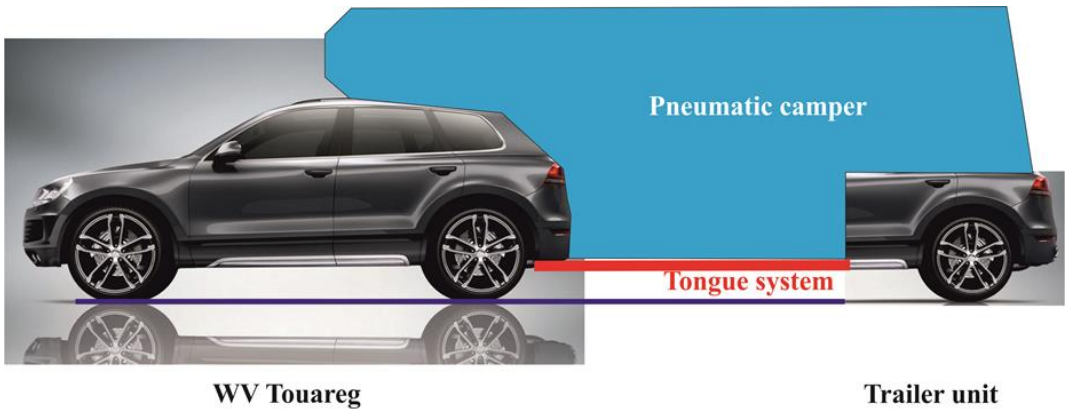


Fig. 5. Principle scheme of pneumatic camper

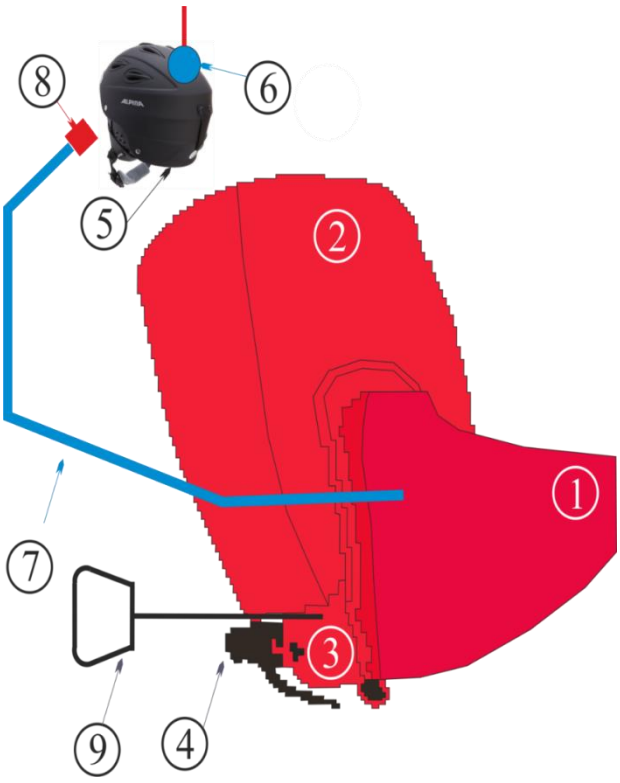


Fig. 6. Principle scheme of avalanche rescue kit

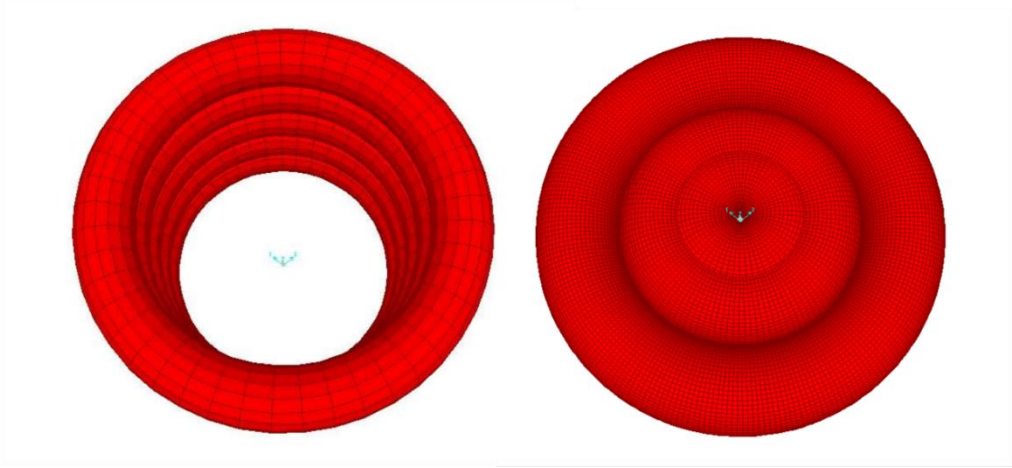

Fig. 7. Toroidal structure of the gas protective shield

**2.6. Gas protective shields**. Principle scheme of gas protective shields is presented in the Fig. 7. These gas shields are used in the energy and military industries [2].

### 3. Conclusions

This report proposes a new generation of eco-friendly wind turbines with high power and air turbines mounted on the automobile. They can be applied in urban environments. Pneumatic camps can deliver up to and over 50 % energy savings when driving on the road. Avalanche rescue kit can be applied to rescue skiers and snowboarders when they get into moving avalanches. Gas protective shield can be applied in the energy and military industries to protect against a sudden uncontrollable blast.

### 4. Acknowledgements

The authors express their acknowledgement for the financial support of this study by the grant COST Action ES1301 FLOWS and special acknowledgement to Bulgarian companies STREZA Ltd and PENTAHRON Ltd for the financial support of the study.

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