STUDIES AND RESEARCH REGARDING THE DESIGN OF THE MECHANISMS FOR OVER-GROUND MULTIFUNCTIONAL PARKING LOTS. THE CONSTRUCTIVE DESCRIPTION AND SEISMIC PROTECTION OF A PARKING LOT ABOVE DAMBOVITA RIVER

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ABSTRACT: *The multilevel parking lot on the round platform with intelligent parking system above Dambovita river shall be designed according to the regulatory documents in force withs seismic protection. The implementation of the photovoltaic panels as an alternative source for electricity production. Perform anti-vibration isolation and anti-seismic protection.*

KEY WORDS parking lot, seismic risk, solar energy.

1. The general description of the multilevel parking lot above Dambovita river

The constructions intended for the vehicles parking are located in areas of public interest, considering the provision of possibilities as constant as possible for exploitation according to the Regulatory Document for the design and execution of parking lots for vehicles NP indicative 24-97, as of 28.11.1999

The multilevel parking lot on a round platform with intelligent parking system shall be located on a structure of constructions made of alloy steels,

standardized STAS 792-49, 793-53, 872-49 and 873-53 and shall be provided with the support points on both margins of Dambovita river. In addition to the vehicles' entry paths, it shall be provided with an access roadway only for emergency vehicles: ambulance, fire brigade and police. The execution of a building of parking lots is proposed on a round platform with staggered levels at the half pace, height regime P+4.[5] The height level is of 2.90. The resistance structure is made of steel. The platforms shall be made of monolithic reinforced concrete with a thickness of 20 cm.

The ascending (descending) ramp to the levels shall be executed on a round

platform (elevator type), between the axes of the ground-floor at the superior levels. In the appointed area, the parking lot shall be provided on four levels and shall have a capacity of 60 parking places.

The parking lot is only intended for the cars with a total authorized mass of maximum 3500 kg. The parking lot shall be provided with two entries from the two driving directions of Splaiul Independentei Boulevard and one exit in the middle. The natural ventilation is ensured on all facades. The parking lot will be equipped with a ventilation installation and the external discharge lines shall be provided and executed so as not to exceed the concentrations of emissions set according to STAS 12974 as well as the provisions of the environmental permits and authorization. In order to reduce the potential noise produced by vehicles, the surface of the façade will be "green facade", that is protected by a network of metal and wood (pergola) which shall constitute the support for the vines. Also, the green area around the building will be arranged and embrasures will be provided on the façade so as to support the vines ascend until the superior levels of the facades so as to create a visual, absorbing screen of the exhaust emissions, respectively with noise absorbing role. The surveillance and management installation of the parking lot shall consist in a surveillance system by television in a closed circuit, barriers, sensors, magnetic coil, entry units, exit units, automatic cashier, the related software, panel signalling the free or occupied spaces. Any building intended for the vehicles parking must be provided with all the utilities necessary for the safe operation, hygiene, health and environmental protection. Also the distance between the over-ground buildings shall be considered and nets or snow fences will be mounted .. A plan for

the prevention and combat of the accidental pollution will be elaborated.

2. The implementation of the photovoltaic panels – alternative solution

The solar energy is available in enormous quantities and it is **ecologic**. The capturing means for the **solar energy** are not polluting and have no harmful effects on the atmosphere as the degradation of the Earth reaches a more and more increasing level, this problems begins to be taken into account by more and more people. In case power supply is produced by **photovoltaic panels**, the percentage of the **solar energy** from the total energy produced on the globe increased in time and as technology grows, solar energy will increasingly be used. [1]

The renewable energy is the energy that is collected from renewable resources, which are naturally replenished on a human timescale, such as sunlight, wind, rain, tides, waves, and geothermal heat. [2]

The effectiveness of a PV technology in general, is directly correlated to the amount of sunlight that it is being exposed to; its power output depends on the amount of light that reaches the solar cell. PV technology is most efficient when it is greeted by a light source at a perfectly perpendicular angle, i.e. forming a 90 degree angle. In order to have four different configurations of PV systems, there are: horizontally Fixed, fixed at the latitude angle, single axis azimuth tracking with tilt angle of 55°, and dual axis tracking PV system. [3].

Along with the operation of the power supply installation an installation with photovoltaic panels may be built The implementation of the *photovoltaic panel systems* is a technical solution which should not be neglected. The new

photovoltaic panels IS4000P consist in 54 polycrystalline solar cells (156X156 mm) manufactured by the most innovative technologies and covered with an anti-reflection layer. The photovoltaic panels are built of solar cells laminated between ethylic acetate vinyl sheets (EVA), ultra-transparent, anti-shock, covered with a specially treated glass so as to build an installation with photovoltaic panels.

Because the earth rotates on an inclined axis and takes an elliptical path around the sun, there is a need to use photovoltaic panels to perform a solar tracking. This solution is not always approved due to the high purchase cost. If a stationary photovoltaic panel is used, it is strategically placed in the sun. [4].

In the article "CONTROL SYSTEM FOR PHOTOVOLTAIC PANELS TRACKER" Assoc. Prof. PhD. Grofu Florin suggests an automatic control system for a dual axis PV tracker. The proposed system will be able to automatically guide PV so that they are always oriented towards the sun. For research experiments, the system can be remote controlled so that it is positioned according to the user's needs. In order to protect the PV and tracker against wind, the system will be complemented by a sensor to determine the direction and speed of the wind. Thus, the system will position PV to a minimum wind resistance.

For the automatic orientation towards the sun, the system will be provided on each axis (Horizontal X, Vertical Y) with a sensor that determines whether the PV is oriented towards the sun as well as a control element of the PV rotation on the respective axis. The system will also have a sensor for the absolute position on each axis to monitor the PV position. [5].

AX,AY -- Actuator with DC motor and gearbox for X,Y axis

DC MDX,DC MDX -- DC Motor Driver for X,Y axis

PX,PY -- Absolute position sensor for X ,Y axis

ST -- Temperature sensor, PN -- Pyranometer

SX,SY -- Sensor for the position towards the sun for X,Y axis
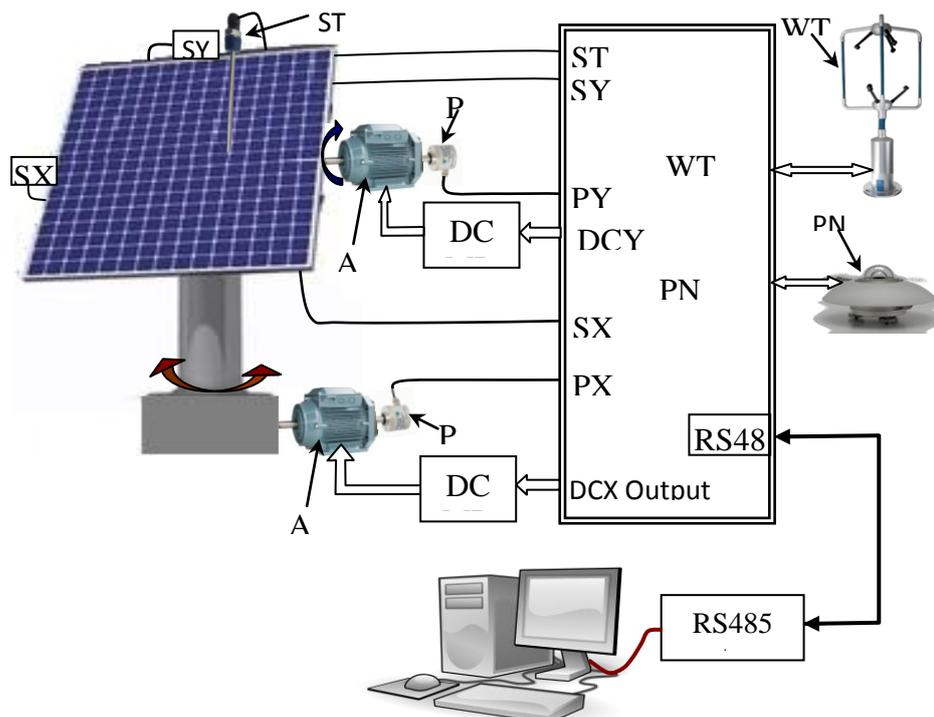
WT -- Wind and temperature sen

Figure 1. Structure of control

3. Conditions for the anti-seismic protection of the parking lot

The anti-seismic protection of the installations and equipment from the parking facilities is performed by complying with the general principles of the Regulatory Normative P100.

For the design of the new constructions the framing of the new buildings in the natural environment and built environment shall be performed so as to avoid the increase of the risks implied by the potential effects, direct or indirect, of future strong earthquakes. In this purpose, it is recommended to limit the construction density, as well as the number of vehicles that may occupy the parking places on long periods of time.

The limitation of this over-ground parking lot's height shall be taken into account. Given that the parking lots will be placed on the margins of the river, the necessary measures for the soil stabilization shall be adopted so as to ensure a proper seismic behaviour of the buildings [6]

The execution of a simple, compact and as much as possible symmetrical structure represents the most important objective of the design because the modelling, calculation, dimensioning, detailing and execution of the simple structures are subjected to much smaller uncertainties and the required seismic behaviour may be imposed for the construction
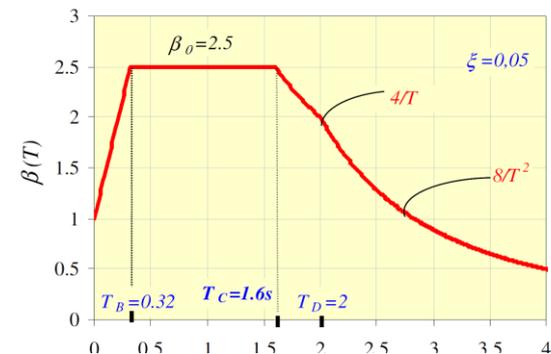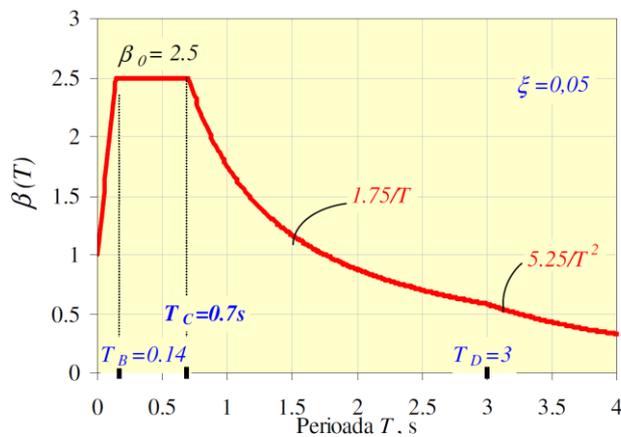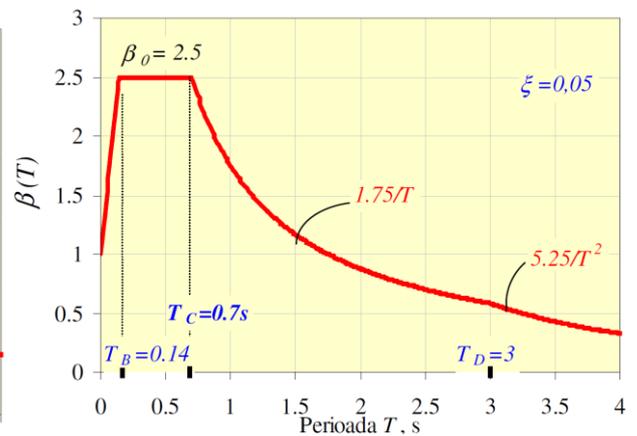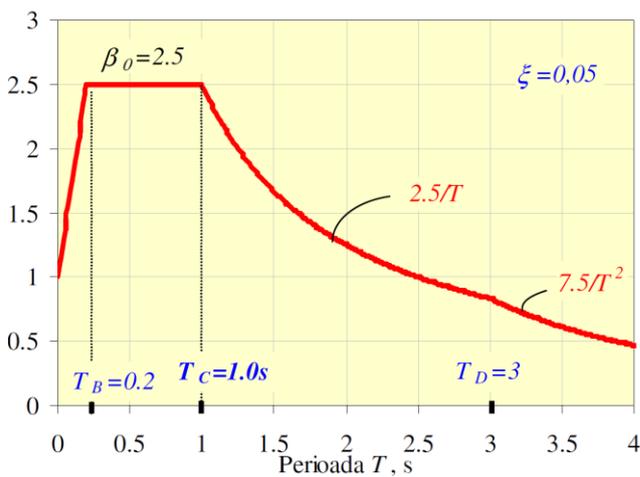
Fig. 2 Normalized spectra of elastic response of the absolute accelerations for the horizontal components of the soil movement T_c =0,7 s, 1,0 s, 1,6 s (SEISMIC DESIGN CODE PART I – PROVISIONS)

The spectrum of elastic response of the relative displacements for the horizontal components of the soil movement, $S\text{De}(T)$ (in meters), is obtained by the direct transformation of the elastic response spectrum for absolute accelerations, $S_e(T)$ with the following relation:

$$S_{De}(T) = S_e(T)\left[\frac{T}{2\Pi}\right]^2$$

(1)

The vertical seismic action for the design of the buildings is represented by the elastic response spectrum of the absolute accelerations for the vertical component of the displacement of the soil in the location S_{Ve} (in m/s) given by the following relation:

$$S_{ve}(T) = a_{vg}\beta_v(T)$$

(2)

Where a_{vg} is the peak value of the acceleration for the vertical component of the soil movement, in m/s2 and $\beta_v(T)$ is the normalized spectrum of elastic response of the absolute accelerations for the vertical component of the

soil movement, T control period (corner).

The peak value of the acceleration for the vertical component of the soil movement a_{vg} is evaluated as:

$$a_{vg} = 0.7\ a_g$$

(3)

The execution of a continuous and sufficiently resistant structural system shall be pursued, that may ensure a structural simplicity, a clear, direct and continuous path of the seismic forces, structural simplicity. The structure must also present, as much as possible, a uniformity on the building's vertical side.

Certain conditions must be observed regarding the seismic design, namely:
- Structural simplicity
- Structural redundancy
- Structure geometry (configuration)
- Rigidity and resistance to translation on two directions
- Rigidity and resistance to torsion
- The diaphragm action of the platforms

(2)

4. CONCLUSIONS

The foundations' system shall be verified according to the provisions of the applicable technical regulations in force regarding the design of the surface foundations.

When the foundations are dimensioned, the effects of the superstructure's action in the combination of loads that include the seismic action

must correspond to the yield mechanism associated to the structure type.

The requirement by design of the aimed yield mechanism (of energy dissipation) is performed by a proper ranking of the resistance capacity of the structural elements (the method "of designing the resistance capacity"

Within the program, "Clean energy for all Europeans", the Committee for Industry, Research and Energy of the

European Parliament (ITRE) set as a mandatory EU objective the increase of the renewable energy percentage to 35%. For the transport industry, 12% of the energy consumed by each EU member state should be produced from renewable sources, such as solar energy or wind energy[7]. This is why for a multilevel parking lot built on a round platform above Dambovita river, it is necessary to implement photovoltaic panels produced by the most innovative technologies with the lowest price possible.

If a stationary photovoltaic panel is used, it shall be strategically located towards the sun. Ideally, the photovoltaic panels will rotate towards the sun, but this is a much more expensive constructive solution.

Of the above, the park foundation has a double role:
- to provide an allowable value of the force that the building of the elevator park, the loaded machinery transmits to the structure and the soil;
- Perform anti-vibration isolation and anti-seismic protection

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