Some Characteristics of Electricity Production by Stationary Parabolic, Cylindrical Solar Concentrator

M. Bojić, N. Marjanović, I. Miletić, J. Malešević and A. Mitić
University of Kragujevac, Faculty of Mechanical Engineering, Kragujevac, Serbia

***Abstract*–Stationary parabolic, cylindrical solar concentrator for electricity production consists of the absorber (with photovoltaic panels and water pipes) and parabolic, cylindrical reflector (with metal surface) and has geometrical concentration ratio up to 4. Direct solar radiation approaches the concentrator aperture at different angles and pathways. For different aperture angles and different kinds and types of metal surfaces of the reflector, the investigation of long concentrator of this type would be that of how efficiently the direct solar radiation reaches absorber to be converted to electricity.**

I. Introduction

Temperature increase has been constantly recorded on the global level. The increase is due to green-house effect because of CO2 emission from different sources in atmosphere. Usually this emission is blamed to combustion of fossil fuels mainly for heating and electricity production. A response to such a situation of world community may be increased use of solar energy for heating, cooling, and electricity production. Solar energy is source of all life on the earth and it is in abundance but dispersed. Here, we propose use of stationary, asymmetric solar concentrator for conversion of solar energy to heat.

The subject of this research (in Centre of heating, air conditioning and solar energy of Mechanical Engineering Faculty at Kragujevac in Kragujevac University in Serbia) is design optimization of stationary asymmetric solar concentrator for heat and electricity production with geometric concentration of up to 4 (see Fig.1 and 2).

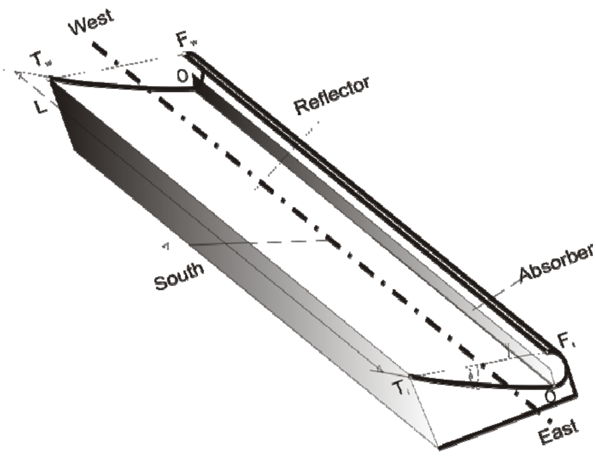

Fig. 1. The concentrator. The concentrator is positioned to have the reflector trough in the direction east-west, while the reflector surface faces south (valid for the north hemisphere)

The stationary (long) solar concentrators have advantages over tracking concentrators as they can be part of building façade and used in building and city architecture.

The conventional solar panels only use half of their available surface area. The bottom half of the panel faces downward. The panel is easily may accept more Solar energy than is incident on the top surface of a conventional panel. Here, illumination of both sides of the panel is performed with non-imaging reflectors. This allows a single absorber to be used instead of the two standard single-sided absorbers. This may represents a substantial cost and materials saving.

Such a design approach has a number of implications:
(a) The panel must be substantially thicker because of the necessity for reflective optics to reside underneath. This can be an aesthetic issue.
(b) The heat loss mechanism underneath the panel is different to that of the top surface.
(c) Additional reflector material must be used. Its cost and pollution must be compared to that of the replaced panel.

This type of concentrators was already subject of intensive research [1-3]. This paper investigates at different altitude angles, the pathways of the direct solar radiation through the concentrator aperture and inside the concentrator by using computer software CATIA. In addition the paper would present results of efficiency of use of light rays at concentrator and efficiency of their conversion to electricity as a function of angles of incident of solar rays for different types of reflector surface.

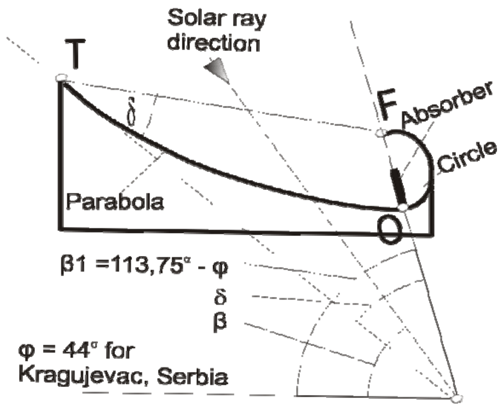

Fig. 2. Vertcal cut throuh the concentrator in the plane perpendicular to the direction east west.