Video 3 documentation

Background of the system and optimizations

Solar Thermal Collecting System with Changing Images Generation

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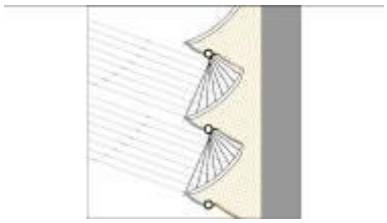
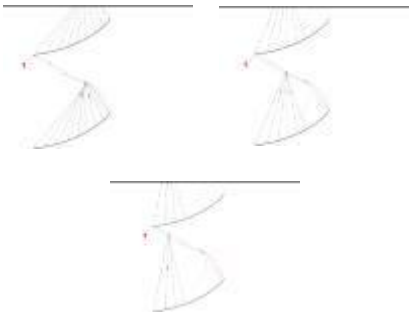
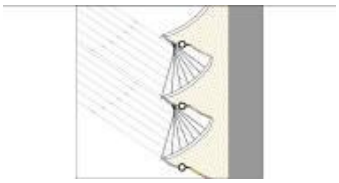
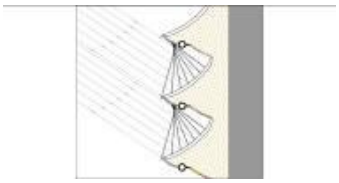
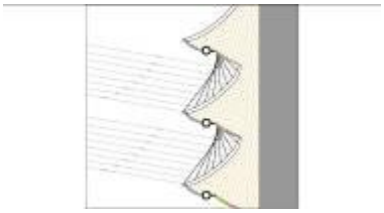
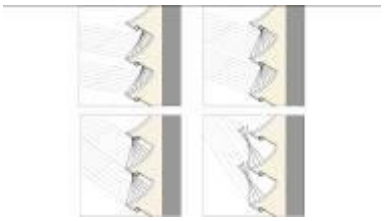
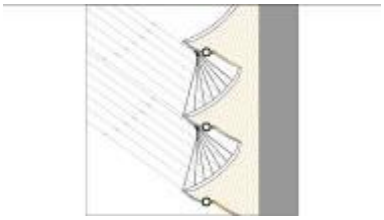
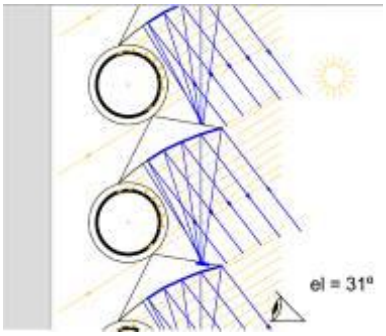
Background of the system and optimizations

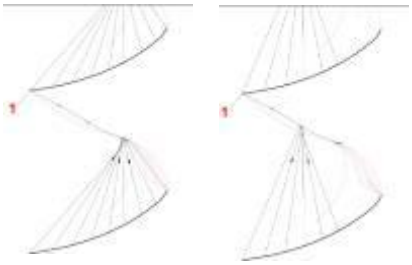
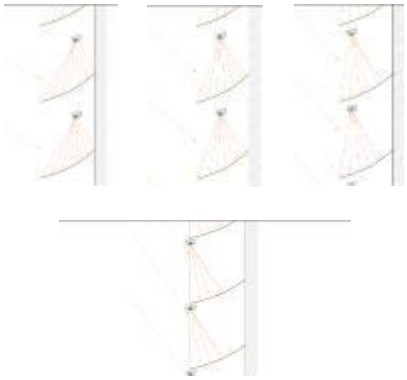
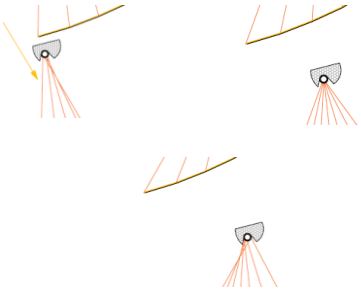
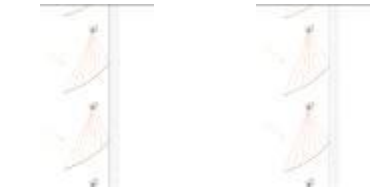
	That video is more technical than the other ones. For that, it could be boring and hardest to understand for inexpert people.
	All the technology is backed up on a basic element that will be named as CAA, made by a little reflexive concentrator, an absorbing area and the surrounding zones to that absorbing area. All these elements are fixed.
	
	
	
	

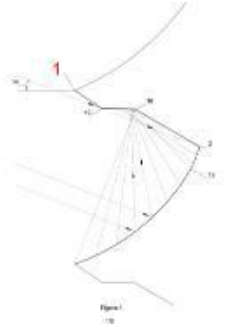
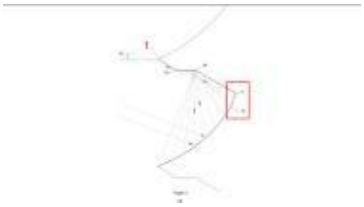
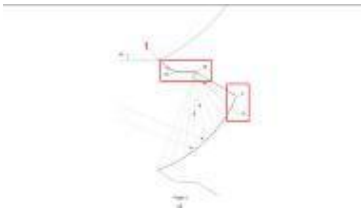
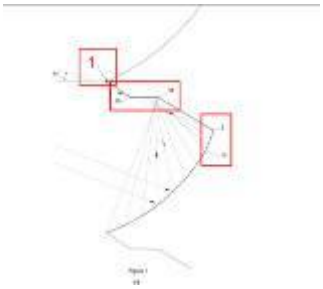
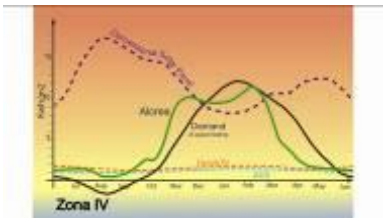
	The system is composed by arrays of extrude elements. That means adjacent rows of lineal concentrators and these elements, which could take up a whole wall.
	
	At the invention, for that basic group, the CAA, the geometry and all the design parameters are determined to optimize the functions and aims. These aims are, collecting or illuminating according to the thermal demand, creating images or changing colours and generating high concentrations.
	
	That optimization could be for any of them, individually, or any combination of these aims.
	Although the concentrator more appropriate is a parabola in which the vertex zone is perfected. Sometimes, an ellipse gives better results and many of these results are applicable to other forms of concentrators.

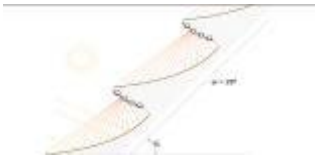
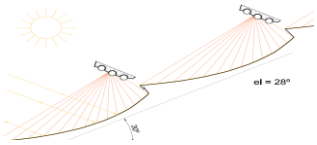
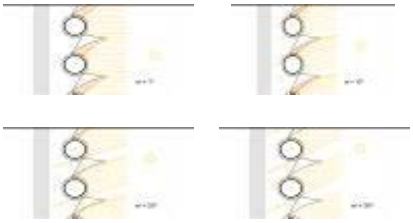
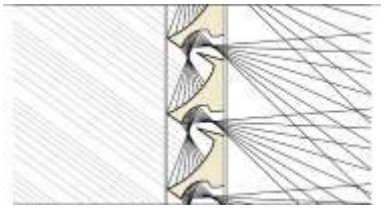
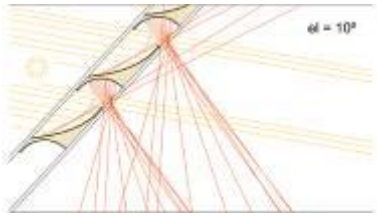
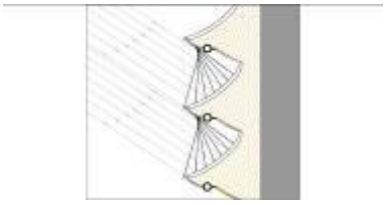
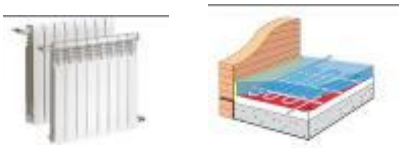
	
	
	
	During the largest part of the day in summer, the sun is high. When this happens, the concentrator reflects the incidental light into the sky. This contributes to refresh the building, the environment, and the planet.
	In spring, autumn and partially in summer, the sun is not so high. In this case the incidental light reaches the zone that is close to absorbing area, but the incidental light does not touch the absorbing area. Due of this, the system does not collect much energy at this time.
	When the solar height is typical of winter, the concentrated radiation falls on the absorbing area that is touching the absorbing area most of time. Therefore, this area collects a lot of energy over the course of the day.
	At first hour in the morning, the reflected radiation falls on the near zone to the absorbing area that is located at the internal side. But the radiation doesn't touch directly the absorbing area, because of this, it is barely collected.
	Although it could seem paradoxical, the sun in winter is during a long time at these low elevations. If this energy was harvested in winter, probably it would be collected also in summer, when is more important to collect as little energy as possible.

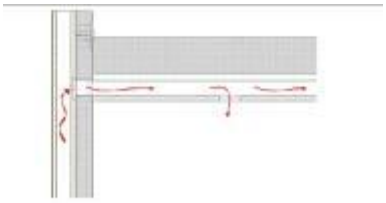
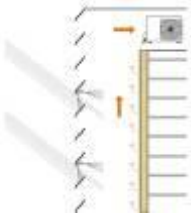
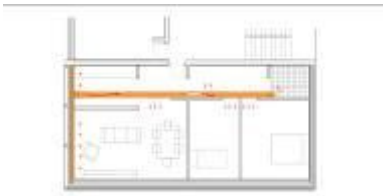
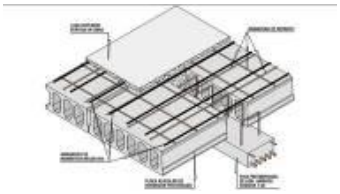
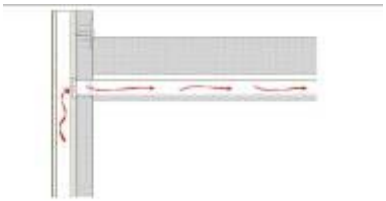
	And also, because to collect that energy, should be expand the absorbing area until these yellow or pink zones. That reduces the collecting efficiency, because the area would be bigger and, therefore, it would have more heat loss.
	That is less certain if the absorbing area is a vacuum tube. They have a very low heat loss coefficient and the vacuum tube could be placed at the black, yellow or pink zone, if that was necessary.
	Anyway, the optimization for each locality or wall orientation determines how much the absorbing area will be extended, for standardized values; the collection would fit to the seasonal demand curve.
	These 4 pictures also show the basic foundation of the generation of images and changing aesthetics.
	When the sun changes its position, the concentrated light falls on the different surrounding zones to the absorbing area. If these zones are coloured, as the image shows, the lit colour stands out from the others. In this way the facade is changing colour along the day.
	Just with this, the effect wouldn't be as spectacular as the simulation shows.
	But as the concentrators are lengthened, in other sections the green zone could be painted in other colour. Thereby, they could form a stripe of pixels along each linear concentrator.
	That is similar to the horizontal stripes of a screen, which form an image on the whole.

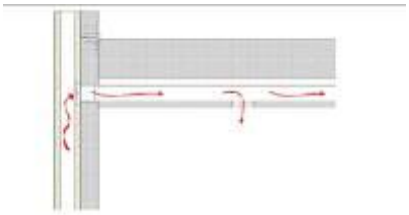
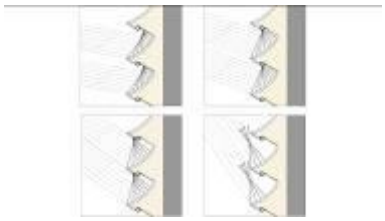
	
	At this case, when the sun changes, other band is illuminated in all the linear concentrators. Then, the image on the facade changes, with an intermediate transition, as is shown at the screen.
	
	Actually, the optimized procedure is pretty more complex and it includes the determination of the form of these adjacent surfaces to the absorbing area. All of this is for generating the largest number of images as possible.
	In addition, it is created a variant and perfection using concentrators which face downward, the opposite to the shown layout. If they are designed according to the patent, they could collect energy at the same time that the images are changing.
	It is also indicated a procedure to minimize costs.
	All of this is explained in detail at the video number 5 about "Generation of changing images on the facade".
	To get high concentrations, it is identified the focus envelope and the geometrical optimizations for getting these concentrations were as high as possible.

	Especially relevant is the position of point 1, which is also the beginning of the next concentrator.
	The focus envelope supposes an additional improvement to the generation of images.
	The geometric place where the maximum concentration is obtained is an undulating curve. This curve with an optimizing design could approximate to a straight line, which begins at the point 1 and finishes at the focus of the parabola.
	When the sun position changes, the zone where the sunbeams are concentrated is in other place of that focus envelope and a pipe, which will move taking up this zone all the time, could be receiving a concentration around 30 or 40 when the elevation rank is approximately 30º.
	Surprisingly, the results considerably improve if the panel is inclined to the ground, instead to the sky as is usual.
	These numbers compete with the systems of tracking a shaft, with the advantage that the pipe could be insulated at the major part of its contour.
	Since the block of parabolas could be very light and be located behind a glass, sometimes could be simpler installing the system fixed and moving the block of parabolas along to a guide. That guide will have the form of focus envelope
	These concentrations are high enough to produce steam and to move a little domestic turbine that generates electricity with efficiency higher than 30%.

	The performance is really greater than for the photovoltaic panels, with the additional advantage that steam or surplus energy would be used to heating, increasing the total efficiency.
	On a different topic, to get the fit to the demand curve, the geometry, the disposition of elements and parameters, which take part at the problem, have been optimized. For example, the maximum and minimum elevation that are expected to be collected.
	As stated, the concentrator is a parabola which has been improved in a zone next to the vertex. However, the ellipse could give better results for some of raised problems.
	That near zone to the vertex is the stretch of the concentrator which stays in shadow when the solar elevation is the maximum which is expected to collect. That is the stretch from 15 to 2.
	This stretch is named surrounding vertex and it is improved for make the absorbing area (from 18 to 19) as little as possible. Or to that concentrations get bigger over the focus envelope, giving as a result a circumference.
	The position of the point 1 is very important during all the optimization process. That position generates the shadows and the position of the next concentrator.
	The place where the absorbing area is located, is determined after the inclination of the shaft of the parabola was optimized, the length of that parabola and the maximum and minimum elevations when the energy is harvested.
	The previous points are the main parameters for the fitting to the thermal demand curve. They have been optimized for several cities around the world. In addition, it have been claimed their correlations with the geographical latitude and the wall orientation with respect to the south.
	Other positive effect about the fitting of the demand curve, which is claimed at the patent, is letting that the linear concentrators are not on the horizontal flat, but they are inclined

	Geometry optimizations are modified when the solutions are for a roof, instead the shown ones, which are for vertical walls.
	
	They are also different if the concentrator is looking down, or according to the system design to improve the collecting, the image generation or a solution about of the combination of both of them.
	Other variant of the technology is to redirect the light and the energy toward the indoor of the housing or the building instead to collect it. It is done by a reflexive surrounding area. As happens with the concentrator, it could be a complex curve, but for optimized design could be an ellipse or a circumference. This could be seen in detail at the video 4.
	
	When the aim is to collect energy, not redirecting the light toward the interior, this is used to heat air or water. Traditionally, this is more usual and easier for the distribution, either as radiators, as a heating floor or as domestic hot water.
	
	In that invention it is taken into account a system, which is a heating wall. This would be install pipes inside a prefabricated concrete wall, and using the external side of it as an absorbing part.

	This even could have the enclosure function and insulation of that wall, such as in that picture.
	However, the solutions that heat air instead water sometimes are the favourites at that invention, by the simplicity and economy at collecting energy.
	As is shown at video number 4, the external air which will be heated could be used to circulate by a heat pump, if it doesn't reach enough temperature to be directly injected to the building.
	Some of these proposals represent new challenges for architects. Using also the changing aesthetics given by that technology, they could get great innovations at edification and at building systems, above all in prefabricated systems.
	The most obvious procedure to use the heated air is to transport it by ducts, to the different rooms of the building. Such as is shown at that image where the heated air in the panels of the left side, at south, is taken toward the northern rooms that are no sunny. However, a greater challenge is to build a floor and walls system with air circuits, not water circuits.
	This is proposed, is to build the ceiling with hollow core slabs and use their ducts to form the serial or parallel circuit. They would cause little pressure leaks, due to the great pass section that they gather.
	The challenge is to get continuity of these circuits, as well as, re-circulating this heated air by the air chambers of the external walls, which have to be insulated. A bigger challenge would be doing that with a slab of hollow concrete blocks.

	In these two cases, the air circulates inside walls and slabs. This air heats them, but without be injected at the rooms. But, could the system be hygienic enough to the air can be injected into the rooms?
	Or, could the backing board (such as plasterboard) be used to achieve a heating wall?
	Could hygienic circuits with backing boards be created and to inject the heated air into rooms? As in this case, the panels are on the left and down, which could be the east and the south, for example.
	On the other hand, it is important to highlight that, in that invention, the concentration is not mainly used to make bigger the collecting efficiency, It is used to control, to get the limitation of the harvesting between the maximum and minimum elevation, without mobile elements.