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# The Zenith Passage of the Sun at the Mesoamerican Sites of Tula and Chichen Itza

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## Abstract

Using software SunCalc.org we can easily observe the alignments of buildings along the direction of the sunset on the day of the zenith passage of the sun, at two Mesoamerican sites. These sites are those of Tula and Chichen Itza.

The tropics are the regions of the Earth that lie between the latitude lines of the Tropic of Cancer and the Tropic of Capricorn. In this zone of the Earth, we have the opportunity to see the zenith passage of the sun, that is, we can see the sun passing at noon directly overhead. The zenith passage happens on two days in the year. These days depend upon the latitude of the place of observation. Let us note that, at the Tropic of Cancer, the zenith passage happens on the day of the June solstice and at the Tropic of Capricorn on that of the December solstice; at the equator, the zenithal sun is observed on the two equinoxes.

When the sun passes overhead, the shadows of objects and persons disappear. As explained in [1], the days when this happens assume a sacred significance for the people that live and lived within the tropics. "A number of legends identify it as a time when the way is open into the upper world" [1]. In some Guatemalan villages, the two dates of zenith passage, which are coincident to the period of rains, are marked by ancient rituals. Also in ancient Hawai'i - Ref.1 explains - the zenith passage of the sun was a moment of great sacred power.

Being the zenith passage so important for people in the tropical zone [2-8], it is not surprising that we can find it evidenced by the local architectures too [3,9-13]. We have, for instance, that some monuments possess a "zenith tube" at their apex [10,14]. It is a vertical sighting tube inserted in the vault of the structure, which produces in a dark chamber a perfectly perpendicular beam of light when the sun is at the local zenith. Alignments of monuments are also possible: we observed them at Sanchi, India [15,16], at the Lion Rock in Sri Lanka [17], at Angkor Wat [18] and at the Sewu, Prambanan and Borobudur Temples in Java [19,20].

Alignments of the monuments in the Mesoamerican site of Chichen Itza are well known [21,22]. "El Castillo appears to be oriented so that the west plane of the pyramid faces the "Zenith passage" [21]. Here we show this alignment using software SunCalc.org and satellite images. This software is an online application used to "to ascertain the sun movement with interactive map, sunrise, sunset, shadow length", and other data. About the use in archaeoastronomy for the simulation of

shadows by means of SunCalc.org, we discussed in [23]

Before observing the alignment of El Castillo, let us consider the site of Tula. Here we show the alignment of the Palacio Quemado (the Burnt Palace) along the sunset on the day of the zenith passage of the sun. In this manner, we can add the site of Tula to the other sites where a worship of the zenithal sun existed.

**The site of Tula.** Tula was an important regional center, that became the capital of the Toltec Empire in the period between the fall of Teotihuacan and the rise of Tenochtitlan [24]. The site is close to the city of Tula de Allende. "The main attraction is the Pyramid of Quetzalcoatl which is topped by four, four metre high basalt columns carved in the shape of Toltec warriors ... The feathered serpent god Quetzalcoatl is linked to this city, whose worship was widespread from central Mexico to Central America at the time the Spanish arrived" [24]. The pyramid of Quetzalcoatl is also known as the pyramid of the Morning Star [25]. The other main structures of the site include another pyramid, two Mesoamerican ballcourts and several large buildings. One of them is the Palacio Quemado (the Burnt Palace) [25]. If we used the SunCalc.org software, we can see that the Palacio Quemado has an orientation along the sunset on the two days of the zenith passage of the sun. The Figure 1 is a screenshot of the result given by the software. We see two lines giving the directions of sunrise and sunset. We have also the curve representing the apparent motion of the sun in the sky. When this line is passing through the site, it means that at noon the sun passes through the zenith. In the Figure 1, we can see that the sunset direction corresponds to the long axis of the Palace.



Figure 1: Alignment of the Palacio Quemado (Tula) along the sunset on the day of the zenith passage of the sun.

**Influence of Tula.** In [24], we find mentioned that there is evidence of Tula influence in other parts of Mesoamerica [26]. "One of the most debated questions is what, if any, relationship there might be between Tula and Chichen Itza far to the south in the Yucatan Peninsula". This debate exists because there are similarities in various art and architectural styles. "It is certain that neither could have conquered the other, but there is evidence that they may have been connected through trade networks " [26]. Ref.24 tells also that the planning of Tula was adopted by some Aztec city-state rulers for their urban centers [26].

After observing the Figure 1, we can add the alignment along the sunset of the zenithal sun as a link to the architecture of Chichen Itza.

**Chichen Itza.** It was a large pre-Columbian city built by the Maya people. The archaeological site is located in the Yucatan. As told in [27], the site displays several architectural styles, "reminiscent of styles seen in central Mexico and of the Puuc and Chenes styles of the Northern Maya lowlands. The presence of central Mexican styles was once thought to have been representative of direct migration or even conquest from central Mexico, but most contemporary interpretations view the presence of these non-Maya styles more as the result of cultural diffusion" [27].

We have mentioned above one of the monuments of the site, El Castillo. It is the Temple of Kukulcan, a Maya deity represented as a feathered serpent similar to the Aztec Quetzalcoatl. It has the form of a step pyramid, consisting of a series of nine square terraces. This pyramid was superimposed to an old temple [27,28]. In the Figure 2, we see a screenshot of software SunCalc.org. We see the alignment mentioned in [21,22].



Figure 2: Alignment of El Castillo (Chichen Itza) along the sunset on the day of the zenith passage of the sun.

**Conclusion.** Here we have shown the peculiar alignment of El Castillo at Chichen Itza using software SunCalc.org and satellite images. By means of this software, we can find that another Mesoamerican site, that of Tula, exists where a building is aligned along the sunset on the day of the zenith passage of the sun. This building is the Palacio Quemado. This reference to the zenithal sun is an architectural aspect which is notably linking the two Mesoamerican sites.

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