The alignment of Casamari Abbey along the moonrise azimuth on Easter 1203

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ABSTRACT. Casamari Abbey is a Cistercian abbey in Italy, about 10 kilometres from Veroli. The building of the church that we see today started in 1203. Here we show that a link can exist between the direction of the moonrise on Easter 1203 and that of the nave of the church. To determine the moonrise azimuth we use software CalSKY. To simulate it on satellite images, we use The Photographer's Ephemeris.

Casamari Abbey is a Cistercian abbey in Italy, about 10 kilometres from Veroli. The abbey was built at the site of Cereatae, the birthplace of Caius Marius. A chronicle of the abbey, written in the 13th century, tells that the Abbey had its origin from a Benedictine monastery of 9th century [1]. In the 12th century, the abbey suffered a long period of decline. In this period, St Bernard of Clairvaux, the promoter of the Cistercian reform of monasticism, incorporated Casamari in his new order. He officially enlisted it in the Cistercian directory as the 29th foundation of Citeaux [1]. Under the Cistercians, the abbey and its church were completely rebuilt, between 1203 and 1217, in accordance with their own standards [1]. Today, Casamari is a well preserved example of the Burgundian early-Gothic architecture. Of this style, another example in Italy is the Abbey of Fossanova [1-3].

It is known that the building of the Cistercian Casamari abbey started in 1203 [1]. Filippo Rondinini in his Monasterii Sanctae Mariae Et Sanctorum Johannis Et Pauli de Casaemario Brevis Historia is telling that "da un antichissimo codice membranaceo conservato dai monaci consta nell'anno del Signore 1203, epacta sesta, indizione corrente, il 6 maggio, nell'anno sesto del pontificato di Innocenzo III, viene posta dal reverendo abate del monastero Gerardo la prima pietra per la nuova basilica, benedetta e rimessa dal detto sommo pontefice" [4,5]. And also that "Per procura di fratel Rajnerio da Ponza, di santa memoria, il papa Innocenzo III getta le fondamenta per la nuova basilica".

Here we will show that a link can exist between the year of foundation and the orientation of the abbey. In particular we investigate the following possibility, *that the nave of the church had been aligned close to the moonrise azimuth of the first full moon after the spring equinox of year 1203.* That is, we consider the possibility that the *abbey was aligned along the moonrise azimuth on Easter 1203*. The proposed discussion is therefore an example of an astronomical analysis, applied to find a possible link of the foundation of a church to the moonrise on Easter.

First, let us note that an orientation of the nave of the Abbey, that is of its man axis, *according to the sunrise on the day of the foundation* (6 May 1203, Julian Calendar) *is impossible*. We can use software CalSKY (see Table 1). We have that the sunrise azimuth, astronomical horizon, on 6 May 1203 had an azimuth equal to 64.4°.

5 May 1203	Rise : 4h39.1m az= 64.8°	Set : 19h03.7m az=295.4°	Transit: 11h51m06s Altitude=66.4° Tau
6 May 1203	Rise : 4h38.0m az= 64.4°	Set : 19h04.7m az=295.8°	Transit: 11h51m03s Altitude=66.6° Tau
7 May 1203	Rise : 4h36.9m az= 64.1°	Set : 19h05.7m az=296.1°	Transit: 11h51m01s Altitude=66.9° Tau

Table 1

It is true that the natural horizon is different from the astronomical horizon. Therefore, let us consider the altitude, on the astronomical horizon, that the sun (or the moon) must have to be seen rising above the natural landscape. Using elevation profiles of Google Earth, in the direction of the nave of Casamari Abbey, we find that the altitude of sun or moon must be 2,3 degrees. To appreciate the difference, let us use the Photographers Ephemeris software. This software is using a proleptic Gregorian Calendar, then 6 May 1203, Julian Calendar, is corresponding to 13 May 1203, proleptic Gregorian Calendar. The result of the simulation - screenshot - is given in the following Figure 1.

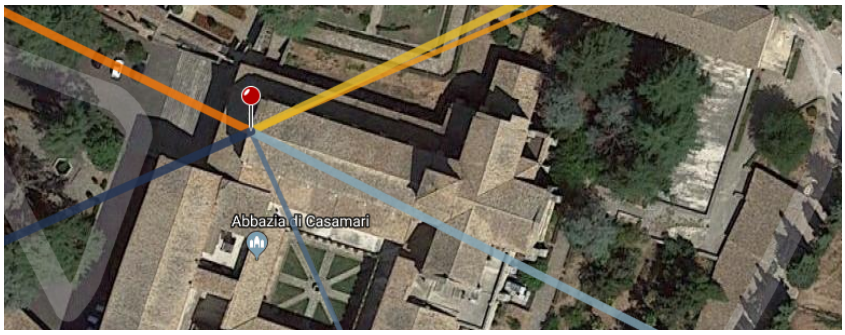

Figure 1 – Many thanks to The Photographer's Ephemeris for the simulation and Google for the satellite images. Let me stress that the image is used for scientific purposes. The sunrise azimuth on the astronomical horizon is represented by the thick yellow line. The sunrise azimuth on the natural horizon (sun altitude 2,3°) is represented by the thin yellow line. It is evident that the nave of the church was not aligned along the sunrise azimuth.

As it is clearly shown by the simulation, *the nave of the church had not been aligned along the sunrise azimuth*. Therefore, let us consider the *moon*. Let us investigate the possibility of a moonrise azimuth close to the direction of Casamari Abbey. The astronomical case that we are here considering is like that shown in the Figure 2.

Also this Figure is a screenshot of the Photographer's Ephemeris. The direction of moonrise on the astronomical horizon is represented by the thick pale blue line. The thin pale blue line is giving the

direction of the moonrise on the natural horizon. The simulation is made on 6 April 1203 (proleptic Gregorian Calendar), that is, 30 March 1203, Julian Calendar.

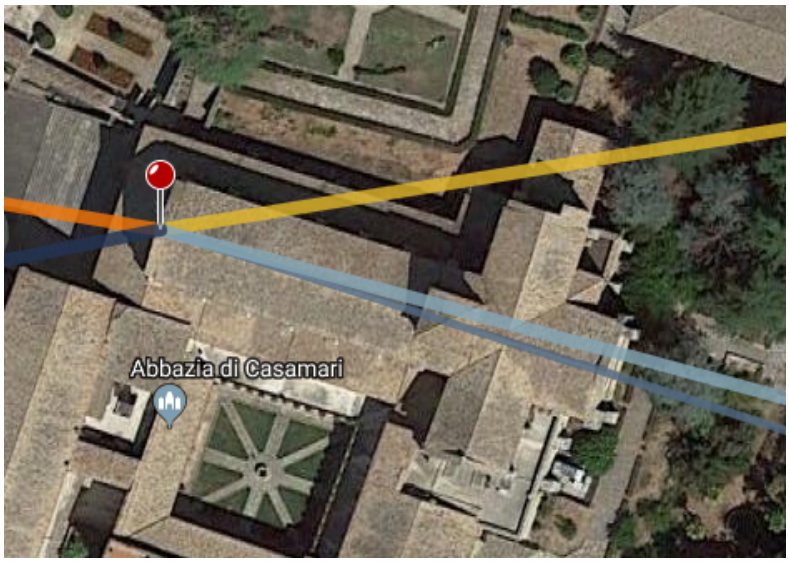

Figure 1 – Many thanks to The Photographer's Ephemeris for the simulation and Google for the satellite images. Let me stress that the image is used for scientific purposes. Moonrise azimuth (thick pale blue line) on astronomical horizon is 105° (within a degree). Moonrise azimuth (thin pale blue line) on natural horizon is 108° (within a degree). The simulation is given on 6 April 1203 (proleptic Gregorian Calendar), corresponding to 30 March 1203 (Julian Calendar).

As we can see from Figure 2, we have a remarkable alignment of the nave along the moonrise direction on 30 March 1203. We decided to use this date because it was import for the Church: it was the Easter of 1203, as we can easily find by using the "computus". It is a calculation that determines the date of Easter in the Julian Calendar [6,7]. Therefore the case seen in the Figure 2 seems representing sunrise and moonrise on Easter 1203. However, let us further investigate the moonrise azimuth, using CalSKY too.

We know that Easter is the Sunday after the first full moon which happens after the spring equinox. According to CalSKY, the spring equinox was on 12 or 13 March 1203 (the sunrise azimuth was 90.3° on 12 March and 89.8° on 13 March - astronomical horizon). The full moon after the spring equinox is given on 29 March 1203 (Julian Calendar), the day before than that we obtained by means of the computus. CalSKY tells that 29 March was Saturday, so 30 March was Sunday and therefore 30 March was Easter 1203.

Saturday 29 March 1203

Object (Link)	Event
Moon	Full Moon (diameter: 30.0805', declination: -2.889°)

Software CalSKY is also giving, day by day, the moonrise azimuth, here in the Table 2.

28 Mar 1203	Rise: 17h42m (az= 90°)
29 Mar 1203	Rise: 18h45m (az= 98°)
30 Mar 1203	Rise: 19h47m (az=105°)
31 Mar 1203	Rise: 20h50m (az=112°)
1 Apr 1203	Rise: 21h53m (az=118°)

Table 2

Let us consider the Figure 2 once more. From satellite images, the direction of the nave of the abbey is 108° (within a degree). The moonrise direction according to the natural horizon has the same azimuth of the church, 108°. The moonrise azimuth on the astronomical horizon is 105° (within a degree). So we are in the same astronomical case of 30 March 1203, given in the Table 2. On that day, the moon was rising on the natural horizon in the direction of the nave of the abbey.

Usually, it is told that churches are oriented according to the sunrise on the day of their foundation (see for instance [8]), but this is not the case of Casamari Abbey. We have the date of the ceremony of the foundation, 6 May 1203, during which the first stone was laid. The orientation of the church was not given by the sunrise on that day, without any doubt. Moreover, it is reasonable that planning and orientation of buildings were prepared and decided before the ceremony. In the case of Casamari, an astronomic link to the moon on Easter 1203 is possible.

Some examples of orientation according to the moonrise are existing (see [9] and references therein). So the case of the Casamari Abbey could be a remarkable example of a church oriented according to the moonrise on Easter, as shown by the simulations obtained by means of CalSKY and the Photographer's Ephemeris. However, it is necessary to note that the alignment of the nave could be simply an occurrence in the absence of any reference to the moon. For this reason, further studies are necessary to investigate other Cistercians abbeys and their possible astronomical orientation, with respect to sun, moon and stars.

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