GEODETIC HIGHLIGHTS

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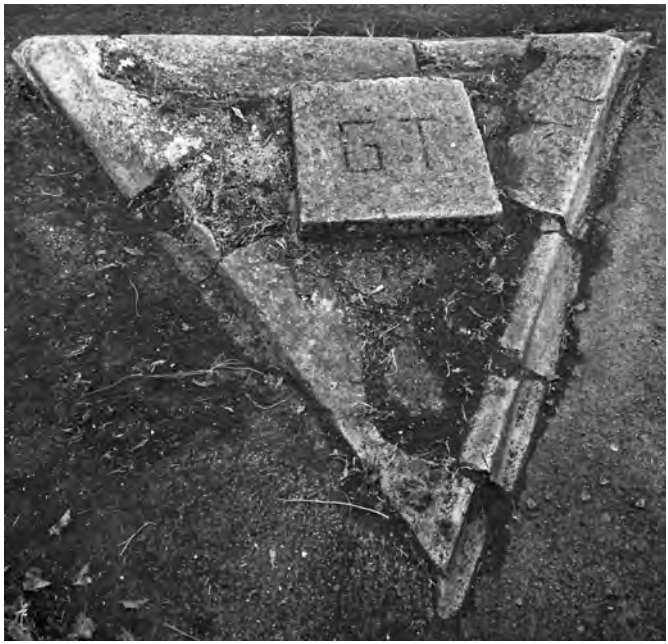

GEODETIC INSTITUTE OF SLOVENIA

GEODETIC HIGHLIGHTS

***Kozinski pil* – Column of Kozina**

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Introduction

This booklet presents some of the important first-order gravimetric points in Slovenia. The first part of the booklet provides a detailed presentation of the geodetic point named *Kozinski pil* (Eng. Column of Kozina), which has served various geodetic purposes in the past. According to available sources, a boundary mark stood at this location as early as the 18th century, marking the boundary between estates and later also the boundary between districts as well as the tripoint between cadastral municipalities. During this period, the point retained its unique, distinctive triangular shape on the ground, which presents a unique feature in the wider area. In the last century, *Kozinski pil* also became a gravimetric point, retaining its role to the present. Gravimetric points are still in use today, enabling, among other things, the implementation of the national coordinate system.

One of the most important tasks of geodesy is the establishment of a national coordinate system, in which the gravimetric component plays a key role in determining the height system throughout the national territory and linking it to those of neighbouring countries. Gravitational acceleration measurements are performed at gravimetric points, with the first-order gravimetric network forming the basis for all further gravimetric measurements. This means that we know the very precise value of gravitational acceleration (g) at these points, which, for example, is 9.8054774 m/s^2 at *Kozinski pil*. Knowledge of the Earth's gravitational field is of great importance in geoscience, as it enables the determination of heights, research into the shape of the Earth (e.g., geoid) and the internal structures of the Earth. The most accurate data on this is still obtained by direct measurements on the Earth's surface, rather than by applying satellite technology.

The second part of the booklet presents other interesting first-order gravimetric points in Slovenia that stand out due to their location and method of stabilisation. Most of these points are stabilised on monumental structures that otherwise have other primary functions, like churches, chapels or other monuments. Nevertheless, it is interesting to learn how these locations are also important for geodesy. By raising awareness of the importance of these points, we are contributing to their preservation so that surveyors can continue to use them in the future.

Let this booklet introduce you to a part of our common heritage, which we preserve from the past and build on for the future. I also suggest that you take a look at other publicly available booklets from the *Geodetic Highlights* collection, as they all bear witness to important and prominent old geodetic points on Slovenian territory. These were used by our predecessors for various geodetic measurements and represent our cultural heritage, although the majority of them are still in geodetic use today.

Dr Klemen Medved,
Director of the Geodesy Office at
the Surveying and Mapping Authority of the Republic of Slovenia

Kozinski pil and first-order gravimetric network

In the old part of Kozina, opposite the house number Pod Videžem 1, there is a triangular base with a square on which the letters GT are written. The triangular base has a side length of two metres, while the inner concrete square with the inscription measures 0.5 × 0.5 m in cross-section. Inside the square is a small metal pin. The carved edge of the triangular base is 20 cm high. Locals call this point *Kozinski pil* (Eng. Column of Kozina). This point has a very interesting history, as it first represented a boundary point between estates, then a boundary point between districts, a boundary point between cadastral municipalities, and today it still serves as a valid gravimetric point.

Kozinski pil today

Location of Kozinski pil and the boundaries of current and former cadastral municipalities.

The significance of Kozinski pil in the past and today

Until around 1927, *Kozinski pil* is believed to have consisted of a triangular stone base, which has been preserved to this day, and an upper stone pillar, which is believed to have been around two metres high. The upper part was removed by the Italians between the two wars when they were rebuilding the main road between Trieste and Rijeka, which today runs just below it. At that time, they also built new embankments walls along the road, and according to locals who heard it from the Italians at that time, the upper part of *Kozinski pil* was built into one of them. One part can be seen just behind the Kozinski pil.

At the same time, the Italians changed the boundaries of the cadastral municipalities of Hrpelje, Rodik and Draga, which until then had joined at the location of *Kozinski pil*, and since then it has only presented a boundary point on the parcel boundary. In 1965, a concrete pillar with the inscription GT was dug into the preserved triangular base, which still represents the valid point no. 20 of the first-order gravimetric network. This gravimetric point is a unique example in Slovenia, where a gravimetric point is located within the remains of a former cadastral municipality boundary marker or an even older boundary marker of former estates.

The silhouette of Kozinski pil, photographed before 1929, can be seen in the outlined square.

Preserved small part of the upper part of Kozinski pil in the wall.

Its name must be at least 300 years old, as it first appears in the description of the Schwarzenberg border by Ludvik Petač from 1711, which has been preserved to this day by historian Simon Rutar in his article *Završniška gospoščina na Krasu (Eng. The Schwarzenegg Estate in the Karst):*

> *»...From there, [the border] goes above the village of Slope, and from there to the border at Rodik and Kerslag (Hrpelje) below the village of Slope and straight to Kozinski pil (a mark along the way). From Kozinski pil, it goes along the road through the Kozinski lands up the middle of the hill to Polanšček above Vrhpole ...«*

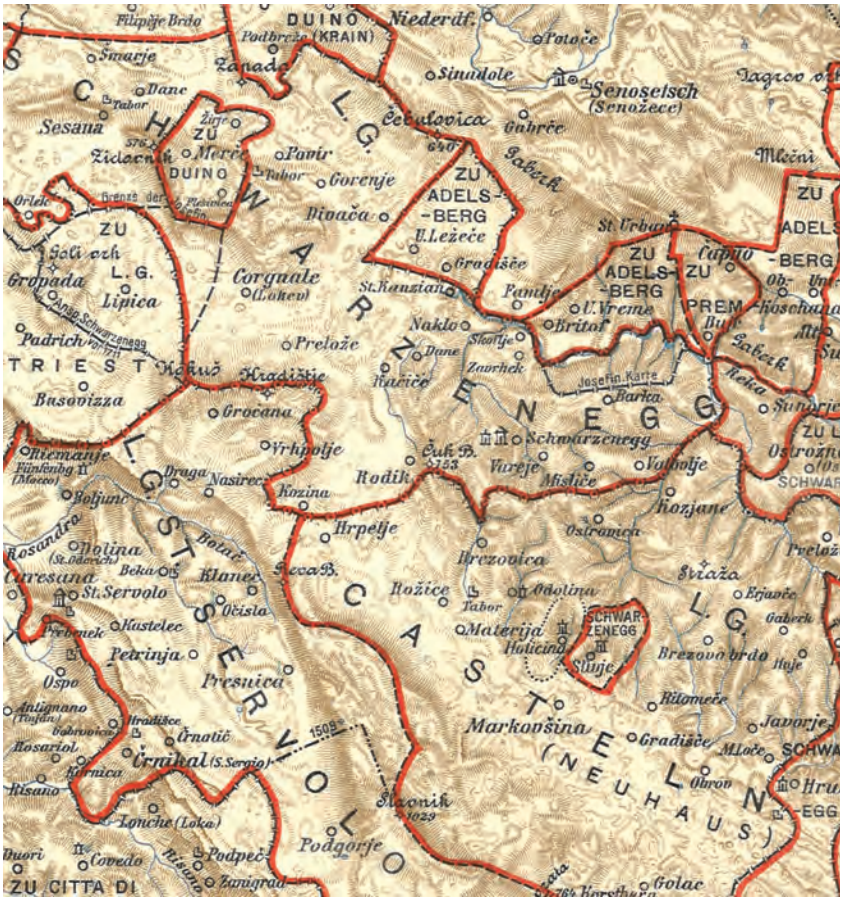
At the time when the first preserved land registers of the Schwarzenbergg provincial court jurisdiction were drawn up in 1574 and 1576, there must have already been a cross standing on this spot, as it is mentioned in the description of the border found in Klelije Potokar's *Kačiče na Krasu:*

> *»... Above the aforementioned village of Slope, the border continues between Rodik (Rodeckhen) towards Hrpelje (Karpellach) and below the village towards the cross at Kozina (Kosina); from the cross there, the border of the Švarcenek estate continues towards the hill above the village of Vrhpoljane (Verch Pollalla)...«*

These two references explain its name Kozinski pil, as the word pil is used by the people of the Slovenian Primorska region to refer to pillars, especially religious stone crosses, stone chapels, and occasionally other roadside signs, such as plague signs. We can conclude that the predecessor of the boundary pillar of the three estates was a cross, which is why this name was retained for the boundary pillar. This is also suggested by the cross on top of the boundary pillar drawn on some land cadastral boundary maps from the Franciscan land cadastral survey produced around 1819.

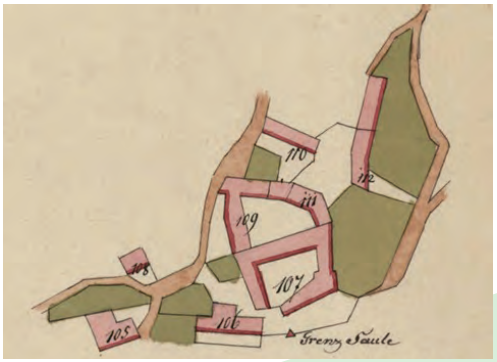
Detail of Kozinski pil on the cadastral maps of the cadastral municipality of Draga.

The border between the three estates of Švarceneg (Ger.: *Schwarzenegg*), Podgrad (Castelnuovo) and Socerb (St Servolo), also known as Mokovo or Robida (Ger.: *Fünfenberg*), intersected in Kozina, and can also be seen on the map of estates from 1776, which can be found in the *Historical Atlas of the Austrian Alpine Countries (Historichen Atlas der österreichischer Alpenländer, 1929*).



The tripoint of the Schwarcenegg, Castelnuovo (Podgrad) and St Servolo (Socerb) estates in Kozina – the estate boundaries in 1776 (source: Historichen Atlas der österreichischer Alpenländer, Landgericthskarte Bl. 35 Adelsberg, 1929).

The triangular shape of the base of *Kozinski pil* first appears on the Franciscan land cadastral maps of the cadastral municipality of Kozina from 1819. On various versions of the cadastral maps of the three adjacent cadastral municipalities *Kozinski pil* is described as a boundary pillar (*Grenz Säule*), boundary stone (*Grenz Stein*) or simply *Kozinski pil* boundary marker (*Cosinsk Pil, u Confino*). The basis for all these cadastral maps is from the period of the Franciscan land cadastral survey from 1819, with later changes made on the maps in red ink during the reambulance survey in 1873.



Kozinski pil in the form of a triangle at the tri-border point on the Franciscan land cadastral map of the cadastral municipality of Rodik from 1819.

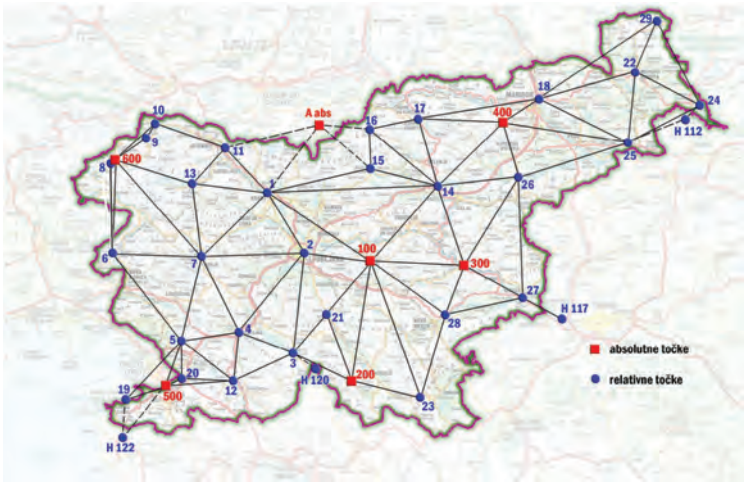
Kozinski pil on the Franciscan cadastral map of the cadastral municipality of Draga.

Kozinski pil on the Franciscan cadastral map of the cadastral municipality of Hrpelje.

Gravimetric networks

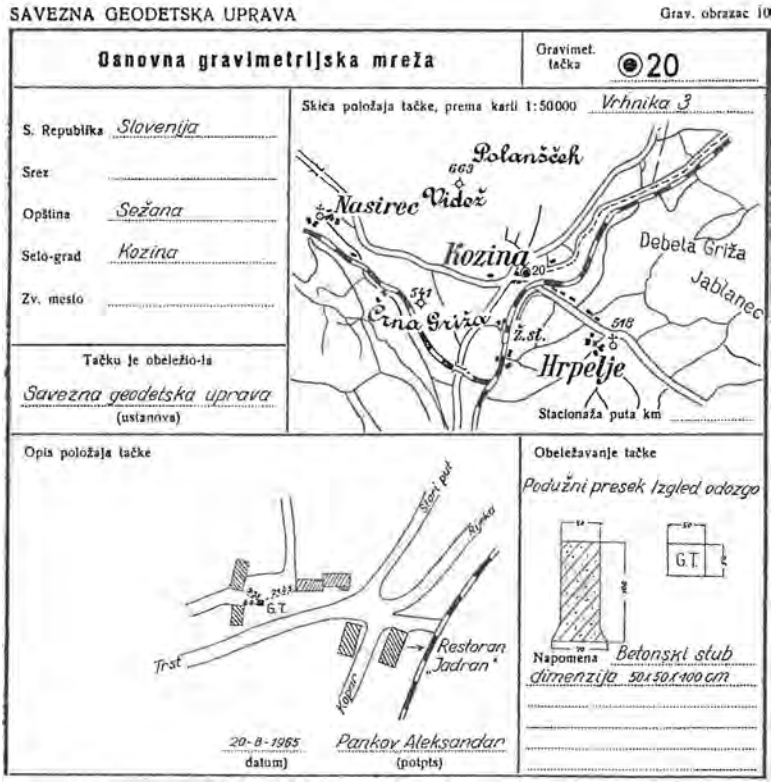
Today, *Kozinski pil* is still a valid gravimetric point (no. 20) in the first-order gravimetric network. Relative gravimetric measurements were last performed on it and throughout the entire current first-order gravimetric network in 2006. *Kozinski pil* is one of 17 still valid gravimetric points that were adopted into today's first-order gravimetric network from the Yugoslav fundamental gravimetric network, on which measurements were carried out between 1964 and 1967. The main points of this network were separated by approximately 30 km from each other. Technical sketches of the location of the point in relation to the surrounding area (named topographies) were made for each point at the time of its stabilisation. In the Yugoslav era there were 31 points of the fundamental gravimetric network in Slovenia: 18 points were represented by a buried concrete pillar with a top cross-section of 50 cm × 50 cm and the letters GT engraved on it, while 13 were smaller crosses carved into the base plates or stone pavements of existing structures such as monuments, chapels and churches. In 2005, it was determined that only 22 points remained useful for new gravimetric measurements. When establishing the new first-order gravimetric network, smaller metal bolts were installed at selected locations of old points that had previously been marked only with a carved cross.

Relative gravimetric measurements are performed at points of the first-order gravimetric network, which enables the very accurate measurement of gravitational acceleration. The network is connected to the zero-order absolute gravimetric network, on which the first absolute gravimetric measurements were performed between 1995 and 2000, followed by measurements in 2014. The absolute gravimetric network includes gravimetric points that are stabilised in the Bogenšperk, Sevnica and Socerb castles, in the Kluže fortress, in the Church of St Areh on Pohorje and in the building of a former military facility in Gotenica.



The zero-order (red) and first-order (blue) gravimentric networks in Slovenia (source: Medved, Koler & Kuhar, 2009).

The Yugoslav fundamental gravimetric network from 1967 for the area of present-day Slovenia. Kozinski pil is no. 20.



Old topography of gravimetric point no. 20 Kozinski pil from the Yugoslav period.

Other interesting first-order gravimetric points

Here a selection of valid first-order gravimetric points will be presented that are located on interesting monuments or buildings, most of which originate from the 1960s. They can be found on monuments that commemorate the events from the First World War (Bovec) and the Second World War (Plave and Izola), but the majority are located in the stone floors of the entranceways of churches or chapels.

The oldest freestanding gravimetric points have the same basic shape as *Kozinski pil*, i.e. a buried concrete pillar one metre high with a top cross-section of 50 cm × 50 cm, with the letters GT stamped on it as well as a small metal pin. Gravimetric points embedded in stone floors and monuments are marked only with small metal pins. Gravimetric measurements are taken on the metal pin itself.

Bovec – gravimetric point no. 8

The gravimetric point, which was established at the time of the establishment of the Yugoslav fundamental gravimetric network, is represented by a small metal pin in the base of the monument commemorating fallen soldiers from the First World War. It is located in the south-western corner of the first step of the monument, on the side closest to the road. The obelisk-shaped monument, built of carved stone blocks, is located north-east of Bovec on the right side of the intersection of the Bovec–Log pod Mangartom and Bovec–Trenta roads, a good 100 m northeast of the military cemetery of the Austro-Hungarian soldiers who fell in First World War on Rombon and Čukla. The monument has already been entered into the national cultural heritage register under heritage number 11707[1].

On the same first step of the monument, on the south corner, i.e. on the opposite side to the road, there is a new benchmark no. 67 from the third order levelling network, which has a larger diameter than the gravimetric metal pin on the opposite corner. Benchmark no. 67 was stabilised in the year 2000. Underneath the newer benchmark, on the lower step covered with earth, i.e. 62 cm below benchmark no. 67, there is also an old benchmark, no. 5496 from the third order levelling network.

[1] *https://geohub.gov.si/ghapp/giskd/?showLayers=MK_EVRD_6832&query=MK_EVRD_6832_0%2CEID%2C1-11707*

The monument to soldiers who fell in the First World War in Bovec on the left, and on the right details of benchmark no. 67 at top and below, gravimetric point no. 8.

Location of the new benchmark no. 67 and the old one no. 5496.

Plave – gravimetric point no. 6

A small metal pin representing gravimetric point no. 6 is located in the foundation of the monument commemorating fallen soldiers from the Second World War in Plave. It is located on the south-western side of the foundation, i.e. the part facing the Soča River. The monument, designed by the architect known as A. Podberščček, is located along the Nova Gorica–Kanal road and shaped like a concrete obelisk with an additional inscription plate. The monument was erected in 1960 and can be found in the national cultural heritage register under heritage number 23994[2]. It started to serve as a gravimetric point in 1965.

Second World War monument in Plave with a white cross where the gravimetric metal pin is located.

[2] *https://geohub.gov.si/ghapp/giskd/?showLayers=MK_EVRD_6832&query=MK_EVRD_6832_0%2CEID%2C1-23994*

Štorje – gravimetric point no. 5

The gravimetric point is in the form of a buried concrete pillar with a top cross-section of 50 cm × 50 cm and the inscription GT. It is located in the immediate vicinity of an old carved stone signpost, both are located near Štorje right next to the road turnoff for Majcne from the Štorje-Štanjel road. The old carved signpost is about one metre high. This point was also erected during the stabilisation of the Yugoslav fundamental gravimetric network.

Old carved signpost with gravimetric point no. 5 next to it.

Izola – gravimetric point no. 19

In the middle of the landscaped Square of the Fallen for Freedom in Izola stands the Monument to the Fallen for Freedom (Spanish fighters, partisans and prisoners), which has the form of a square pedestal with a pyramidal obelisk, on top of which stands a five-pointed star. The monument was erected after the Second World War and is already listed in the national cultural heritage register under heritage number 07235[3].

The gravimetric point has the form of a small metal pin on the southern side of the monument, on the lowest step of its pedestal. Like *Kozinski pil*, this gravimetric point has been preserved since 1965.

Monument to the Fallen for Freedom in Izola and detail of gravimetric point no. 19.

[3] *https://geohub.gov.si/ghapp/giskd/?showLayers=MK_EVRD_6832&query=MK_EVRD_6832_0%2CEID%2C1-07235*

Vršič – gravimetric point no. 9

The point is located at the top of the road to Vršič on a meadow just above the old Rapallo border column, which stands at the 0.0 km road sign. The gravimetric point has the form of a buried concrete pillar with a top cross-section of 50 cm × 50 cm and the inscription GT. This point has also been preserved from the Yugoslav period.

In the old Rapallo border column, on its side looking toward the road, closer to the ground, there is also a convex round benchmark no. 53 from the new first-order levelling network, which was erected in 2000.

Gravimetric point no. 9 and Rapallo boundary marker on Vršič.

Golovec in Ljubljana – gravimetric point no. 2

The old Yugoslav gravimetric point no. 2 in Ljubljana has the form of a buried concrete pillar with a top cross-section of 50 cm × 50 cm and the inscription GT. It is located in the garden of the astronomical and geophysical observatory on Golovec Hill in Ljubljana. The observatory was built between 1954 and 1959.

Gravimetric point no. 2 in the garden of the astronomical and geophysical observatory on Golovec Hill in Ljubljana.

Kranjska Gora – gravimetric point no. 10

The same type of gravimetric point, i.e. a buried concrete pillar with a top cross-section of 50 cm × 50 cm and the inscription GT engraved on it, is also located in the garden of the Church of the Marijino vnebovzetje (Eng. Assumption of Mary) in the very centre of the town of Kranjska Gora[4].

Additionally, the church bell tower itself represents one realisation of fourth-order trigonometric point, no. 349, in the Jesenice trigonometric district.

Gravimetric measurement at gravimetric point no. 10 in the garden of the Church of the Marijino vnebovzetje in Kranjska Gora.

[4] *The Church of St Marijino vnebovzetje, or Marija on Belem produ, is listed in the cultural heritage register under number 01932: https://geohub.gov.si/ghapp/giskd/?showLayers=MK_EVRD_6832&query=MK_EVRD_6832_0%2CEID%2C1-01932*

Pyramid in Maribor – gravimetric point no. 18

Let us now take a look at the gravimetric point located at the top of the Pyramid Hill in Maribor. It was stabilised in 2005 as part of the establishment of a new first-order gravimetric network in Slovenia. The point is marked with a small metal pin located on the upper step of the Chapel of St Mary on the Pyramid[5] in Maribor.

The bell tower of the chapel also represents the one realisation of fourth-order trigonometric point no. 123(C) from the trigonometric district of Maribor.

In the retaining wall of the road leading to the top of Pyramid Hill, about 50 m lower than the chapel, there is also a benchmark no. N1334, which was stabilised in 2022. The benchmark is part of the new first-order levelling network.

The Chapel of St Mary on the Pyramid Hill in Maribor.

Gravimetric point no. 18.

Sighting location at trigonometric point no. 123C.

Benchmark no. N1334.

[5] *The Chapel of St Mary on the Pyramid Hill is listed in the cultural heritage register under number 06274: https://geohub.gov.si/ghapp/giskd/?showLayers=MK_EVRD_6832&query=MK_EVRD_6832_0%2CEID%2C1-06274*

Velika Nedelja – gravimetric point no. 25

A small metal pin, which represents a first-order gravimetric point, is embedded in the stone floors of the main entrance to the parish church of St Trojica (Eng. St Trinity)[6] in the town of Velika Nedelja.

The church bell tower also represents the second realisation of fourth-order trigonometric point no. 214(C) from the Ptuj trigonometric district. The centre of this trigonometric point is located along the railway line, a good 600 m away.

The church of St Trojica and detail of gravimetric point no. 25.

Sighting location at trigonometric point no. 214C.

[6] *The Church of the Holy Trinity in Velika Nedelja is listed in the cultural heritage register under number 00799: https://geohub.gov.si/ghapp/giskd/?showLayers=MK_EVRD_6832&query=MK_EVRD_6832_0%2CEID%2C1-00799*

Gravimetric points as heritage

Kozinski pil is listed in the national cultural heritage register under heritage number 31160[7]. It is an exceptional example of an old geodetic point that is still valid today, with its geodetic purpose having changed over time. Documented since 1711, when it represented a boundary point between estates, from the end of the 18th to the beginning of the 20th century it represented a boundary point between districts, from 1819 to the beginning of the 20st century it was also a boundary stone between three cadastral municipalities, and from 1965 onwards it first served as a fundamental gravimetric point of the first-order network in Yugoslavia, and after 2006, a first-order gravimetric point in Slovenia. *Kozinski pil* demonstrates how a location or object in space can change its geodetic role over time, in this case from an estate boundary marker to a gravimetric point.

The other gravimetric points presented in this booklet are mostly located in the stone entrance floors of churches or monuments that are already listed in the cultural heritage register. The meaning of these monuments is only supplemented by additional geodetic content.

Similar stories may also be hidden at other geodetic points, and therefore we must protect them at the sites where they currently are, because despite their venerable age they may still have an administratively valid role in geodetic or other records today. A stone found in nature can be a boundary marker, a trigonometric, gravimetric or other geodetic point, and even a witness to the history of the administrative division of our space.

More details about Kozinski pil and gravimetric networks are available in the following papers:

Triglav Čekada, M. (2025): ***Column from Kozina – from the cadastral municipality boundary mark to the gravimetric point.*** Geodetski vestnik, vol. 69, no. 1, pp. 69–74.
https://geodetski-vestnik.com/arhiv/69/1/69_Triglav_Cekada.pdf

Medved, K., Kuhar, M., Stopar, B., Koler, B. (2009): ***Adjustment of gravimetric network of Slovenia.*** Geodetski vestnik, vol. 53, no. 2, pp. 223–237.
https://www.geodetski-vestnik.com/arhiv/53/2/gv53-2_223-238.pdf

Koler, B., Medved, K., Kuhar, M. (2006): ***Project for a new first-order gravimetric network of the Republic of Slovenia.*** Geodetski vestnik, vol. 50, no. 3, pp. 45–60.
https://www.geodetski-vestnik.com/arhiv/50/3/gv50-3_451-460.pdf

[7] *https://geohub.gov.si/ghapp/giskd/?showLayers=MK_EVRD_6832&query=MK_EVRD_6832_0%2CEID%2C1-31160*

Scan the QR code to view the digital booklet on the Kozinski pil

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