

## GEODETIC WORKS FOR THE NEEDS OF INDUSTRIAL PARK “LONIĆI” IN CROATIA

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**Summary:** *Industrial parks are areas zoned and planned for industrial development, in Croatia most often initiated by investment of local municipalities. Industrial parks are designed as areas of regular parcels with built road network and utility infrastructure. This work is mostly focused on geodetic works concerning design and construction of road network in the Industrial park Lonići in the Municipality of Bibinje. There are shown geodetic works in all of the stages, such as production of special purpose maps, resolving of ownership issues, staking out of road elements on the field, monitoring of construction works and, in the end, survey and report on the final state.*

**Keywords:** *Industrial park, Lonići, road network*

### 1. INTRODUCTION

Industrial parks are areas in the city or municipality that are intended and planned for industrial use. Industrial parks may contain heavy industry (oil refineries, chemical plants, plastic manufacturers, steel manufacturers, food and beverage processors, etc.) and/or objects for human traffic and distribution of goods (airports, ports, warehouses, distribution centers, etc.).

In Croatia industrial parks are mostly initiated by investment of local municipalities in hope of attracting companies that will establish a business in their municipality and hire members of local population. Besides investment in industrial park infrastructure, municipalities usually offer local tax incentives and exemption from communal fees for certain time for businesses to locate there. Industrial parks are built outside of residential area, as close as possible to traffic infrastructure (freeways, railroads, airports, etc.), so complete utility infrastructure, road connections and road network must be designed and

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built from scratch. In this paper, geodetic works concerning design and construction of road network for the needs of the Industrial park Lonići in the Municipality of Bibinje are presented. Geodetic works are shown in all of the stages, such as production of special purpose maps, resolving of ownership issues, staking out of road elements on the field, monitoring of construction works and, in the end, survey and report on the final state.

### 2. GEODESY IN DESIGN AND CONSTRUCTION OF ROADS

Road construction is a complex job in which geodesy has significant role. Geodesists participate from the very beginning by producing maps for design, till the end by producing final state report. Immediate geodetic works in design and construction of roads are [1]:

- production of special purpose maps,
- production of land parcels expropriation and land parcels subdivision projects,
- horizontal and vertical staking out of road axis, and of all objects in, above or under the route,
- calculation and control of the works on pavement construction,
- calculation of conducted excavation works,
- production of the final state report – geodetic maps as part of the geodetic project for building registration, a document necessary for obtaining usage permit.

In addition to the aforementioned, geodetic works also include the maintenance of operational geodetic network [1].

For the needs of construction of road network of Industrial park Lonići first geodetic works started in June 2008, by production of special purpose map. After the main project was produced by civil engineers, expropriation and subdivision of land parcels started and it was done in 2010. In February 2011 first staking out of road axis was conducted. Construction of road network was done in 2016 when final state report was produced.

In Croatia, quality of performed works on construction of roads is controlled according to ordinance *General technical conditions for road construction* [2], and it contains technical conditions for construction, assurance methods and quality assessment (minimum quality requirements for materials, products and works) as well as calculation of performed works.

### 3. PRODUCTION OF SPECIAL PURPOSE MAP

After the investor obtains location permit based on conceptual design project and spatial planning, special purpose maps are made. Special purpose maps are maps with highlight putted on height or topographic representation, and they must be authorized by competent authority for state survey and real estate cadaster [3]. Special purpose maps are produced and serve as basis for design. Survey for making this type of maps includes positional and height survey of the actual state, which includes roads, objects, fences, utility lines, utility objects, waters, parcel borders and similar, as well as characteristic

terrain profiles. Authorized special purpose map is delivered to the investor in analogue and digital form so it could be used for design and planning.

Special purpose map for the needs of design of road network for Industrial park Lonići was produced in June 2008. Area which is covered by location permit was surveyed using GNSS receiver Magellan ProMARK 500. Stone walls, parcel borders, existing roads, objects, characteristic terrain points and profiles for better height representation were surveyed (Figure 1).

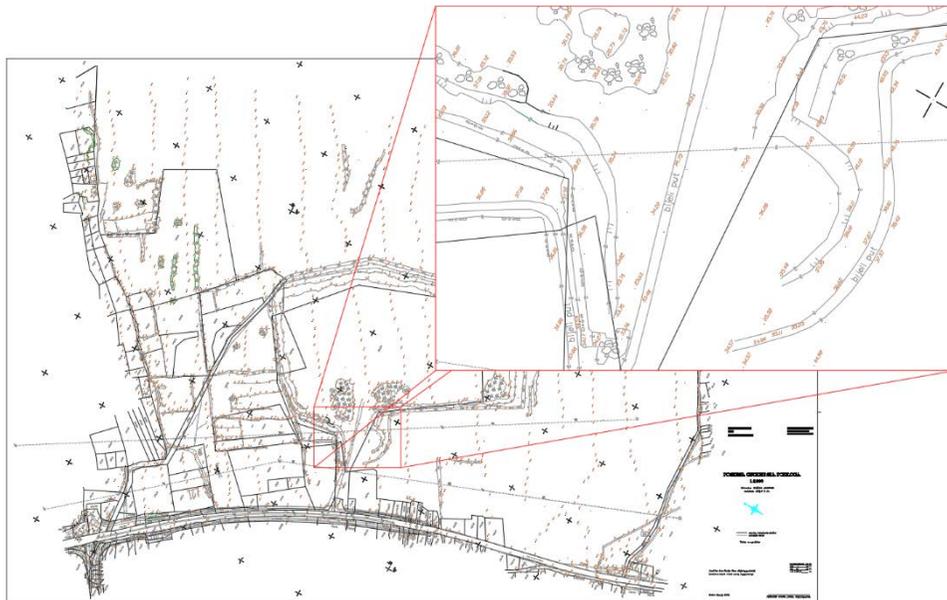


Figure 7. Special purpose map with enlarged detail

#### 4. MAIN PROJECT

Special purpose maps are delivered to civil engineers, which serve them as a basis for design of a road network, utility lines, sewerage system, etc. During design, civil engineers may have requests for additional information about project area. In that case, geodesists conduct partial survey and produce updated special purpose map.

After design is done, main project containing maps and blueprints of all building object elements is made with other descriptive documents. The construction may only begin when building permit is issued, which is a certificate that main project is made in accordance with the prescribed and specified conditions that must be fulfilled by the building at a certain location. The building permit is issued for the construction of the whole building object, except where it can be issued on the request of the investor and on the part of the building object [4].

For geodesists, most important parts of main project are ground plan, and longitudinal and transversal profiles of the building object. That map and profiles serve as basis for further tasks, such as expropriation, production of land parcels subdivision projects and

calculation of staking out data. Main project of road network of Industrial park Lonići was made in June 2010 (Figure 2). All boundaries in both subdivision projects were surveyed using GNSS receiver Thales Magellan “MobileMapper CE”.

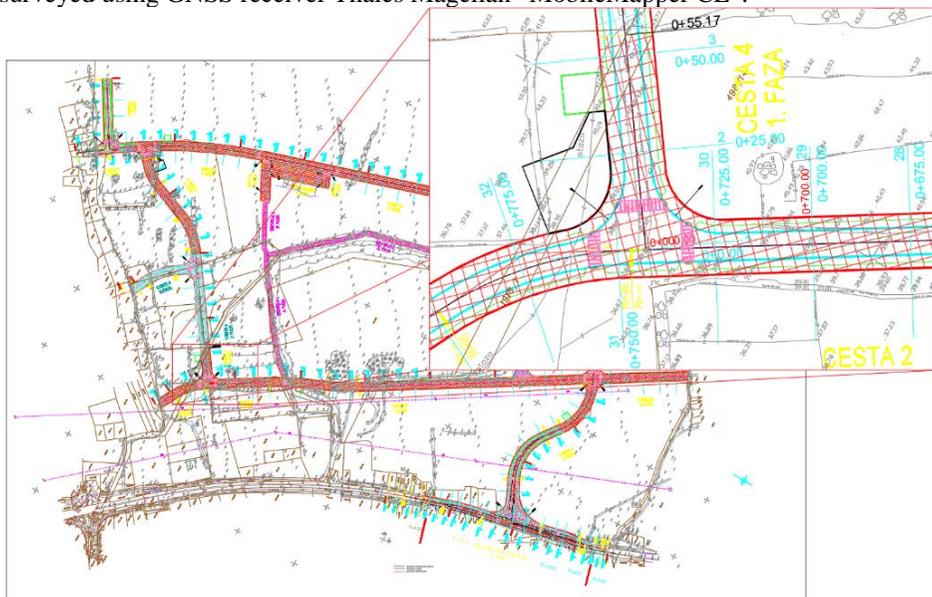


Figure 8. Industrial park Lonići main project ground map with enlarged detail

## 5. LAND PARCELS SUBDIVISION PROJECTS

Based on location permit, land parcels subdivision projects were made. In the first phase of subdivision projects, in April 2010, land parcels were divided into new smaller land parcels. New land parcels that describe outer boundaries of the planned roads were created (Figure 3, left). Thirteen land parcels in cadastral municipality Bibinje was divided into 44 new land parcels, from which eighteen will be under constructed road and belonging objects and that land parcel boundaries were marked on the field with iron spikes.



Figure 9. Details of land parcels subdivision project maps –  
Left: first phase – division; Right: second phase – merging

In the second phase, in January 2011, from eighteen newly created land parcels, ten were merged into one land parcel that describes segments of the road network (Figure 3, right). New land parcel boundaries were additionally marked on the field with iron spikes.

## 6. STAKING OUT OF ROUTE AXIS

Part of main project is report on geometrical elements of the road: lines and arcs. Those elements are defined with several attributes: start point coordinates, end point coordinates, start point mileage mark, end point mileage mark, horizontal length and start bearing direction. Beside aforementioned, arcs have additional attributes: radius, change of bearing direction, end bearing direction and horizontal lengths of tangents. All geometric elements of the road must be marked on the field. Procedure of transferring characteristic points of those elements from project to the field is called staking out. Through that procedure, characteristic points of building object are temporarily, but strongly marked on the field. Besides geometrical elements report, staking out project contains staking out map (Figure 4). On the staking out map all those characteristic points are marked with mileage marks.



Figure 10. Staking out map with enlarged detail

First staking out of Industrial park Lonići road network was conducted in February 2011 by using GNSS receiver Magellan ProMARK 500. Main route axis was staked out and all characteristic points were marked with iron bolts. Whole staking out project containing staking out elements, maps and list of characteristic points was delivered to investor and further to building contractors and their geodetic department. During construction of roads, after each vertical element (layer) of road, building contractors geodesists needed to survey performed works, compare new state with main project, and then again stake out characteristic points, horizontally and vertically.

## 7. FINAL STATE REPORT

Final state report is a geodetic map which is a part of the geodetic project for building registration, a document necessary for obtaining usage permit. Final state report is produced when construction or phase of construction of any building object is over.

After the Phase 1 of Industrial park Lonići road network was completed, in June 2016 final state survey and then report was completed (Figure 5). Survey for the needs of finale state map production was carried by means of GNSS receiver Magellan

ProMARK 500. Pavement, curbs, traffic islands, utility lines, sewerage, walls and similar objects were surveyed for the needs of final state map production.

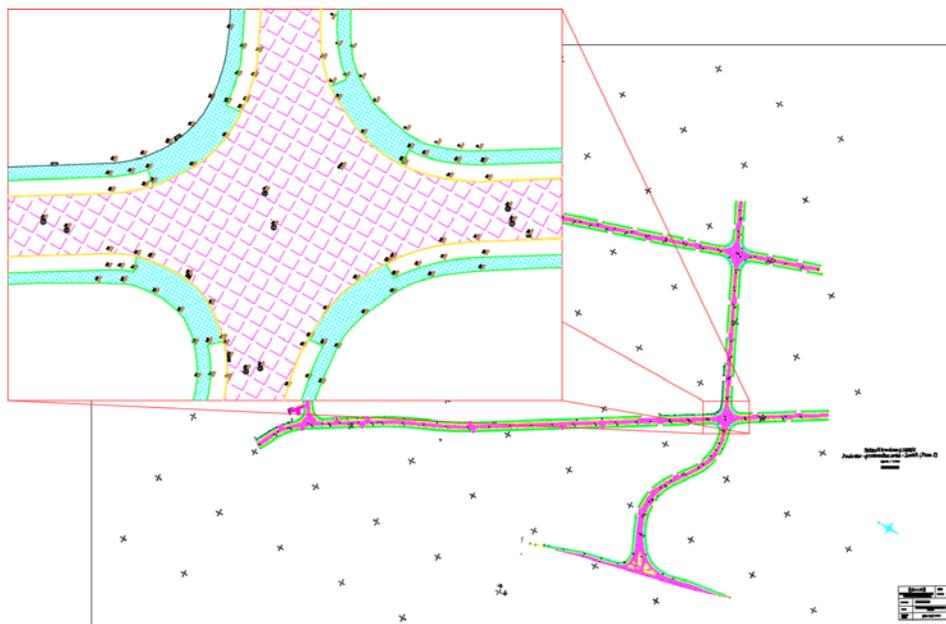


Figure 11. Final state map with enlarged detail

## 8. CONCLUSION

Geodesists have a great role in road construction and they participate from the very start in preparatory works in a form of making special purpose maps for road design, in production of land parcels expropriation and land parcels subdivision projects, staking out of projected objects, calculation and control of the works on pavement construction, calculation of conducted excavation works, and in the end production of the final state report, a document necessary for obtaining usage permit.

In this paper geodetic works conducted for construction of Industrial park Lonići road network in Municipality of Bibinje has been presented: production of special purpose map, land parcels subdivision projects, staking out of route axis and final state report.

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## ГЕОДЕТСКИ РАДОВИ ЗА ПОТРЕБЕ ИНДУСТРИЈСКЕ ЗОНЕ ЛОНИЋИ У ХРВАТСКОЈ

*Резиме:* Индустијске зоне су простори уређени и планирани за индустријски развој, у Хрватској најчешће покренути улагањем локалних опћина. Индустијске зоне су пројектиране као подручја правилних парцела с изграђеном цестовном мрежом и комуналном инфраструктуром. Овај рад се фокусира на геодетске радове који се односе на пројектирање и изградњу цестовне мреже у индустријској зони Лонићи у Опћини Бибиње. Приказани су геодетски радови у свим фазама пројектирања и изградње, као што су израда посебних геодетских подлога, рјешавање власничких проблема, исклечење цестовних елемената на терену, праћење грађевинских радова и, на крају, елаборат изведеног стања.

*Кључне речи:* Индустијска зона, Лонићи, цестовна мрежа