Dynamic Light Conference, Wismar, Germany,
March, 2019

# Dynamic Lighting in Town of Sušice — surroundings of the chapel of St. Angel the Guardian

**Vítězslav Malý | Porsenna o.p.s.**

PORSENNA

## Town of Sušice

## Selection of the Pilot Locations

## Pilot Location

# Town of Sušice

sušice
BRÁNA ŠUMAVY

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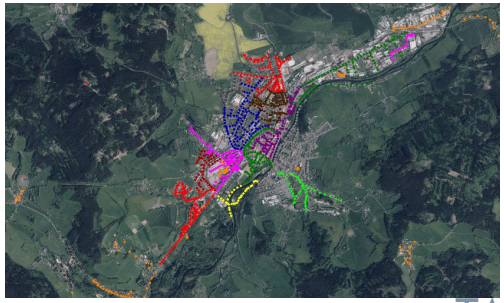
# Town of Sušice

## Town of Sušice

| | |
|---|---|
| Area: | 45,63 km$^2$ |
| Population: | 11 146 inh. |
| Number of lighting points: | 1 444 pc |
| Installed power input: | 118 kW |
| Electricity consumption: | 540 MWh/year |

### Public lighting system

| | |
|---|---|
| Relative number of LP: | 7,7 inh./LP |
| Relative input: | 82 W/LP |
| Relative consumption: | 374 kWh/year/LP |
| Cost of electricity: | 750 CZK/year/LP |



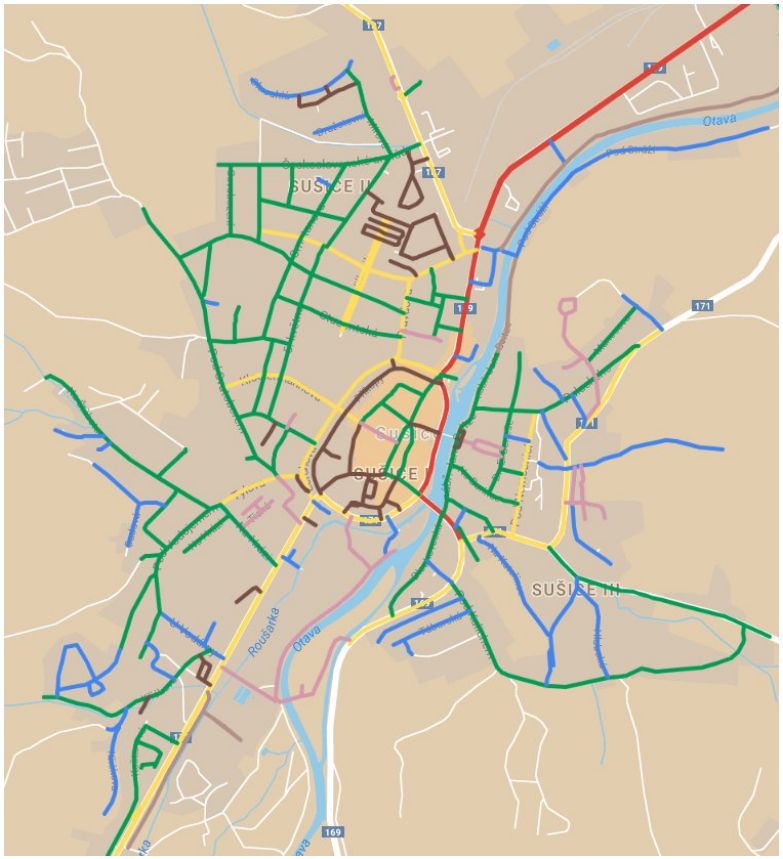
### Project Dynamic Light

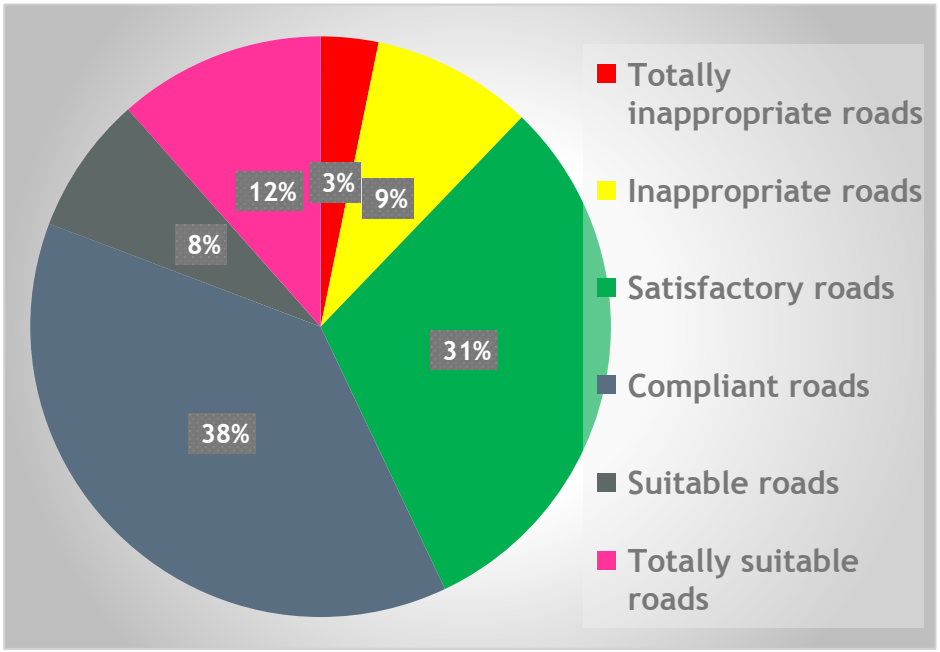
The Concept of public lighting in Town of Sušice

- Analysis of public lighting
- Strategy of public lighting
- Action Plan of renewal and modernization
- Public lighting standards

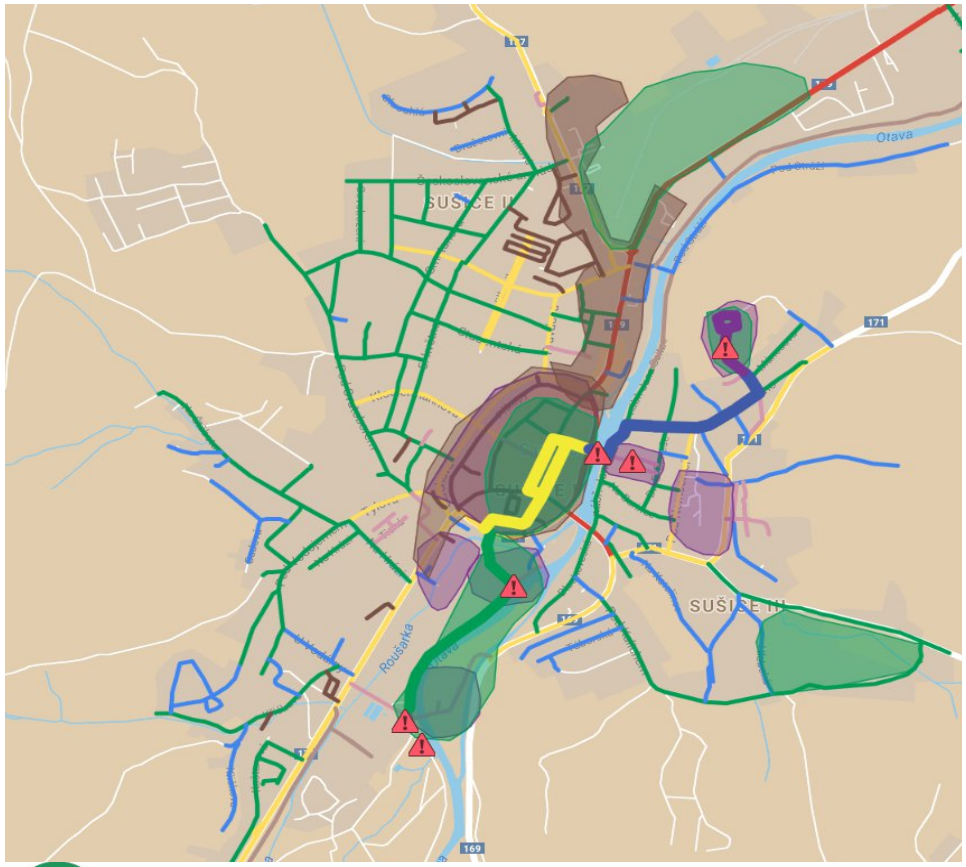
# Selection of the Pilot Locations

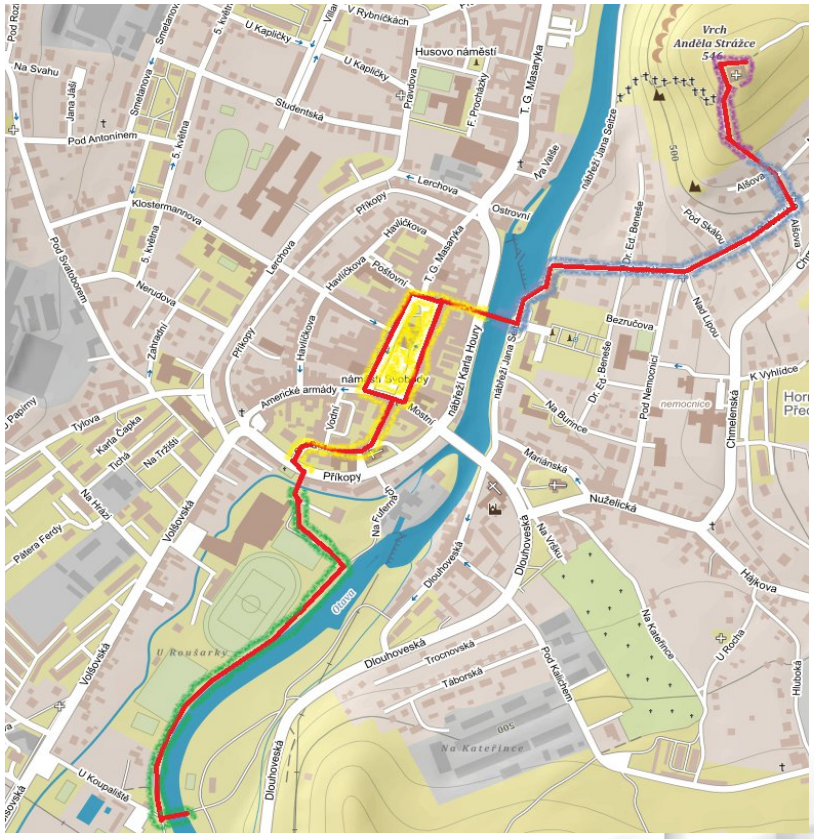
# Road classification - suitable roads



# Selection of suitable location for use of dynamic control

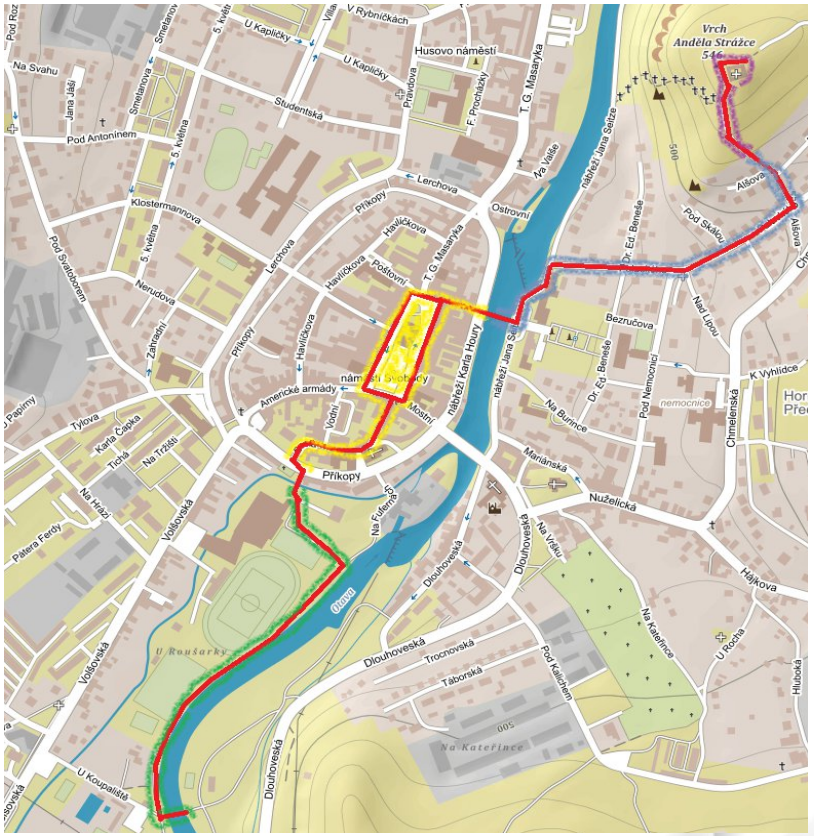


# Selection of Pilot Location

The pilot is divided into four parts:

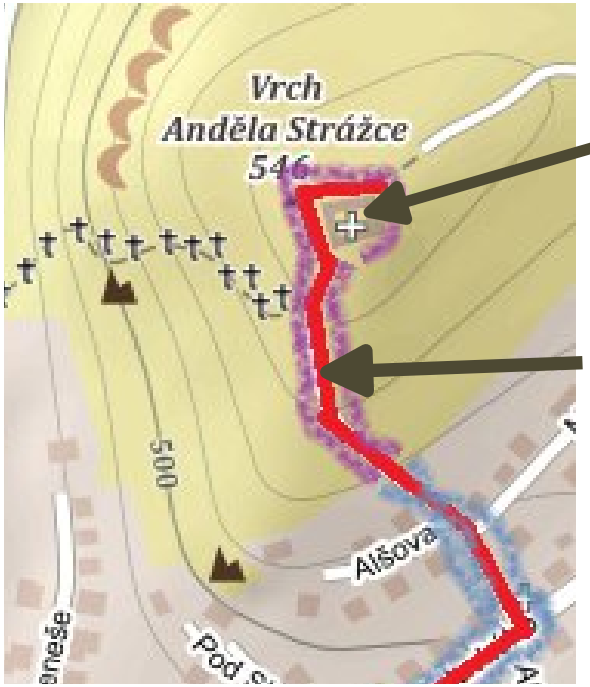
- Road „Otavská St.“ (green),
- City Centre; Nám. Svobody (yellow),
- Route from „Nábřeží Karla Houry“ (blue), to the chapel St. Angel the Guardian
- Surroundings of the chapel of St. Angel the Guardian (purple).



# Pilot Location - surroundings of the chapel of St. Angel the Guardian

# Surroundings of the chapel of St. Angel the Guardian

- Staircases (from Alšova Street)
- Surroundings of the chapel
- the chapel of St. Angel the Guardian



# Initial state of lighting

**Starecases – public lighting**

- 5 pcs of historic lanterns - cast-iron luminaires; 70W HPS
- large pitch of luminaires along stairway & insufficiently illuminated

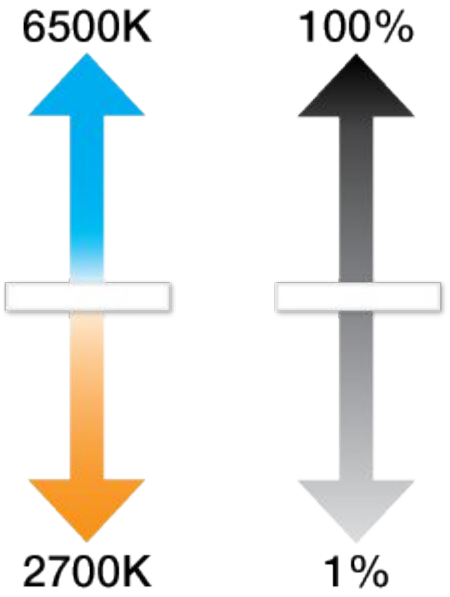
**The chapel of St. Angel the Guardian – architectural lighting**

- 2 light points with 250W floodlights for metal-halide lamps (on the masts)
- one lighting point on facade of the chapel (floodlight 250W)
- the floodlight primarily illuminates the chapel for views from the city center
- large proportion of the luminous flux radiated outside of the illuminated object
  - this luminous flux contributes to the light pollution of the environment

## Lighting Concept - Surroundings of the chapel of St. Angel the Guardian

- Preservation of the decent atmosphere
- Improve stairway lighting
- Retrofiting of historical lantern + dynamic control
- Better plastic appearance of the illuminated chapel
- Illumination of the entire chapel structure
- Increased energy efficiency
- Reduction of obstructive light
- Dynamic lighting control (illumination, color temperature)
- Monitoring the presence of people on the stairs
- Remote control (PLC)

# Lighting Concept - Surroundings of the chapel of St. Angel the Guardian




**PUBLIC LIGHTING**

Changes in lighting conditions based on:

- centrally preset time modes
- information from motion sensors mounted on masts

**The variable parameters are:**

- level of illumination
  - change in accordance with the time mode
  - change in accordance with the presence of people
- color tone of the light
  - change in accordance with the time mode
  - changes are independent of the street lighting modes (dimming)
    - two levels of chromaticity are used for defined time period
      - 2 700 K
      - 4 000 K

# Lighting Concept - Surroundings of the chapel of St. Angel the Guardian

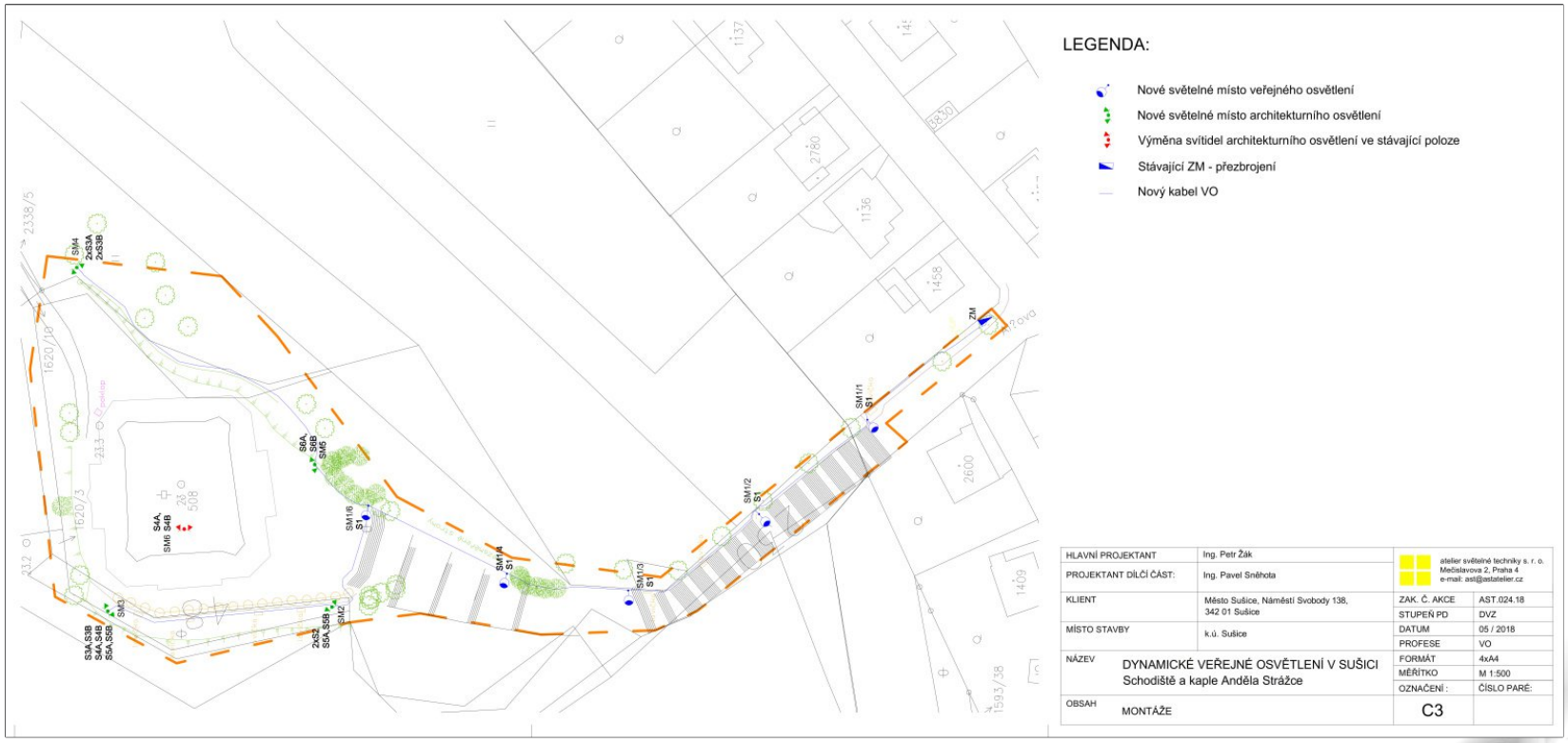
## ARCHITECTURAL LIGHTING

Variable parameters
- adjustable level of illumination
- color tone of the light

Setting of parameters
- will not change overnight
- changes by the day mode
  - workdays
  - weekend
  - holiday
- In accordance with the season mode

- Smooth regulation of luminous flux
- The illuminance level & chromaticity temperature can be adjusted individually
- The level of illuminance can be increased above the normal operating level
- Floodlights with variable chromaticity temperature (tunable white)
  - range 3 000 K - 5 000 K

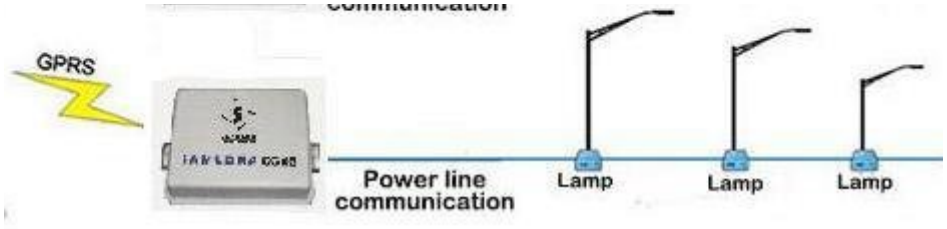
# Lighting Concept - Surroundings of the chapel of St. Angel the Guardian



## Public lighting

- Rebuild the existing historic cast-iron luminaires for high pressure sodium lamps (HPS)
- HPS 70 W replaced for 60 W LEDs
- fluent luminous flux control
- tunable color tone ranging from warm white to neutral white tone
- connection of the motion sensor
- communication with luminaires by PLC (Power Line Communication)
- control center (Getway) in the switchboard - communication via GPRS
- operating time modes of luminaires are in accordance with the "Public Lighting Standards of town Sušice"

## Architectural lighting



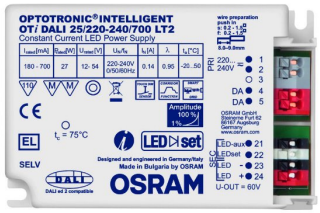

illumination of the chapel

- LED floodlights
- different performances
- different radiating angles
- optional chromaticity temperature
- PLC communication units for independent control of luminaires

- operating profile of the lighting system is set and controlled centrally

## Lighting control

- power line communication (metal wires)
- protocol for control of luminaires: DALI
- all luminaires are controlled centrally
- lighting points are connected with the switching point trough the DALI data bus and PLC
- the switching point are equipped with an RF unit for communication with the central control unit (remote control)
- floodlights for architectural illumination of the Chapel
  - fitted with a dimmable DALI ballast
  - used LEDs with a variable chromaticity temperature in the range of 3 000 to 5 000 K (tunable white)
  - floodlight equipped by glare sh



# Parametr of the street lighting

## Lighting mode - Common

| Time | ON - 21:59 | | 22:00 - 5:59 | | 6:00 - OFF | |
|---|---|---|---|---|---|---|
| Mode | Adaptive – standard level | | Adaptive – low level | | Adaptive – standard level | |
| | presence | absence | presence | absence | presence | absence |
| Illuminance | 80% | 40% | 40% | 20% | 80% | 40% |
| | 4lx | 2lx | 2lx | 1lx | 4lx | 2lx |

## Lighting mode - Ceremonial

| Time | ON - 21:59 | 22:00 - 5:59 | | 6:00 - OFF |
|---|---|---|---|---|
| Mode | standard | Adaptive | | standard |
| | | presence | absence | |
| Illuminance | 100% | 60% | 40% | 60% |
| | 5lx | 3lx | 2lx | 3lx |

# Parametr of the street lighting

## Values / levels of Illuminance

| Mode | Note | Illuminance $E_m$ (lx) |
|---|---|---|
| 1. maximal | ($E_m$=100%) | 5 |
| 2. standard | EN 13201-2 | 3 |
| 3. adaptive | presence | 2 |
| 4. adaptive | absence | 1 |

## Color temperature modes

| Day time | From | To | Color temperature $T_{cp}$ (K) |
|---|---|---|---|
| Evening | ON | 21:59 | 4 000 |
| Night | 22:00 | 5:59 | 2 700 |
| Morning | 6:00 | OFF | 4 000 |

# Parametr of the architectural lighting

## Modes and Surface brightness values

| | Work day | | Weekend | | Ceremonial day | |
|---|---|---|---|---|---|---|
| Facade | $L_m$ (Cd/m$^2$) | $E_m$ (lx) | $L_m$ (Cd/m$^2$) | $E_m$ (lx) | $L_m$ (Cd/m$^2$) | $E_m$ (lx) |
| West | 3,7 | 15 | 5 | 20 | 7,5 | 30 |
| East | 2,5 | 10 | 3,7 | 15 | 5 | 20 |
| South | 1,5 | 5 | 2 | 7 | 3 | 10 |
| Nord | 1,5 | 5 | 2 | 7 | 3 | 10 |

## Color temperature modes

| Season | Standard | Weekend & ceremonial |
|---|---|---|
| Spring | 4 000 K | 3 500 K |
| Summer | 4 000 K | 3 500 K |
| Autumn | 2 700 K | 3 500 K |
| Winter | 2 700 K | 3 500 K |

## Energy balance

**Power consumption of the reconstructed section of street lighting:**

- Existing installed power input 425W
- Installed power input of a new system 300W
- Power change ΔP = - 125W

**Power consumption of the new architectural lighting:**

- Existing installed power input 825W
- Installed power input of a new system 720 W
- Power change ΔP = - 105W

## Before reconstruction

- Total input 1,25 kW
- the expected time of operation
  - street lighting 4 315 h/year
  - architectural lighting 2 127 h/year
- Annual power consumption
  - $W_{tot}$ = 3,58 MWh/rok

## After reconstruction

- Total input 1,02 kW
- the expected time of operation with a dynamic control
  - operation of street lighting 4315/year
  - operation of architectural lighting 2 127/year
- Annual power consumption
  - 2,45 MWh/year

# Costs - Surroundings of the chapel of St. Angel the Guardian

**I. phase**

- rebuild 5 lighting points
- rebuild luminaries (replacing HPS with LEDs)
- installation of 5 floodlights for architectural lighting of the stairway
- Dismantle old architectural lighting

Costs:

- Disassembly: 75 000 CZK
- Lighting points: 640 000 CZK
- Ground work: 270 000 CZK
- Cables and electro material: CZK 140 000
- Surfaces: 50 000 CZK
- Power supply and switching point: 50 000 CZK
- Other: 15 000 CZK
- **Phase I: 1 240 000 CZK**

**II. phase**

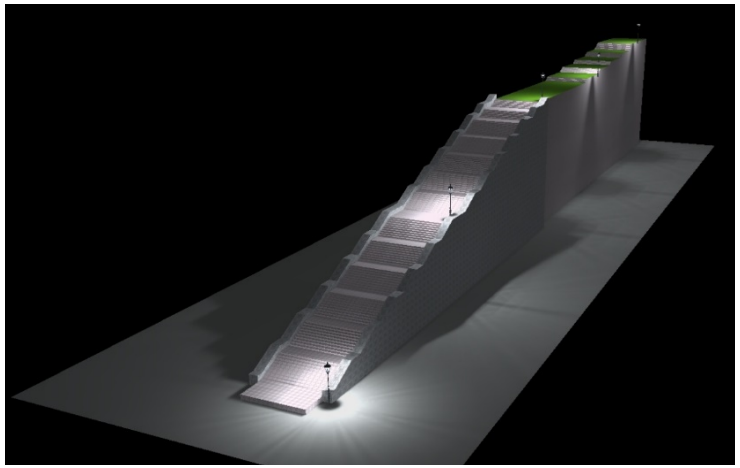
- build architectural lighting for distant views (hill with the chapel)
- installation of 9 pieces of LED spot lights

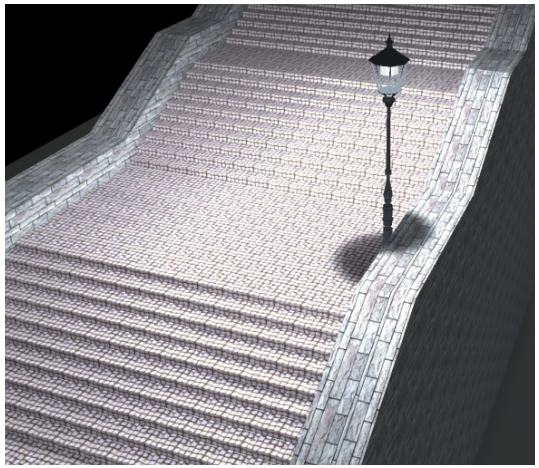
Costs:

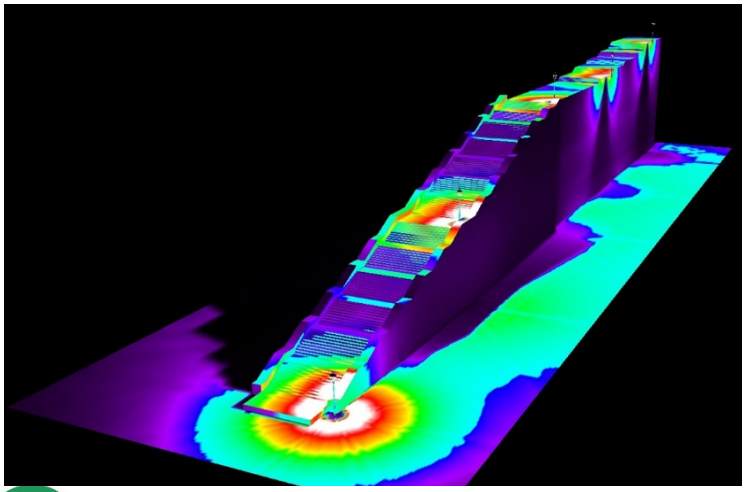
- Disassembly: 210.000 CZK
- Cables and electro material : 40 000 CZK
- Power supply and ground work: 50 000 CZK
- Other: 10 000 CZK
- **Phase II: 310 000 CZK**

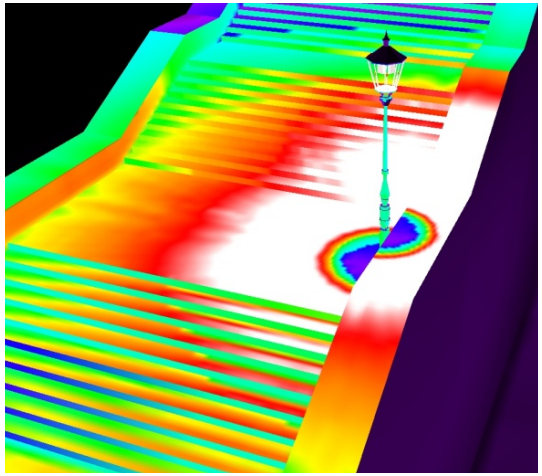
**TOTAL**

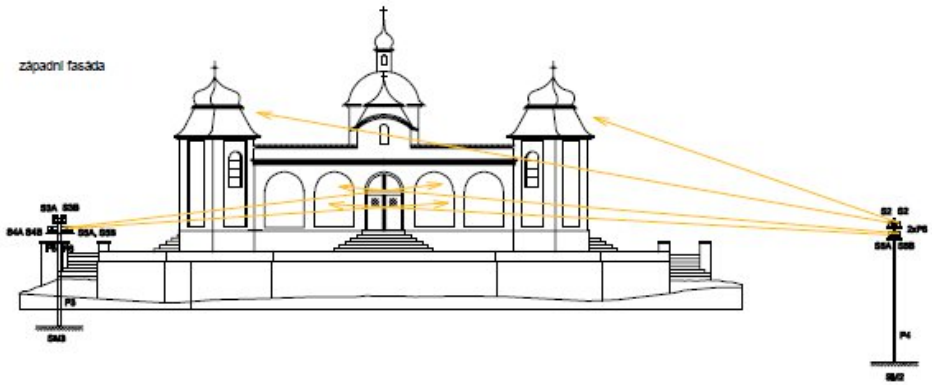
- I. & II. phase
- Pre-realization preparation about 150 000 CZK
- **Total = 1 700 000 CZK (68 000 EUR)**







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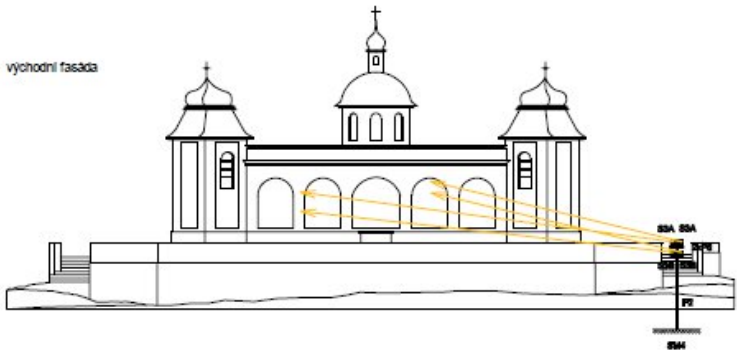
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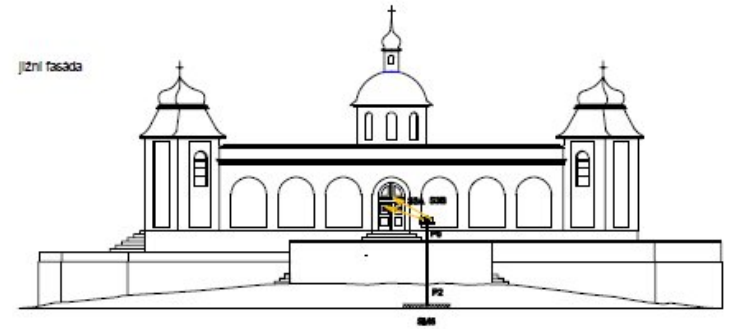
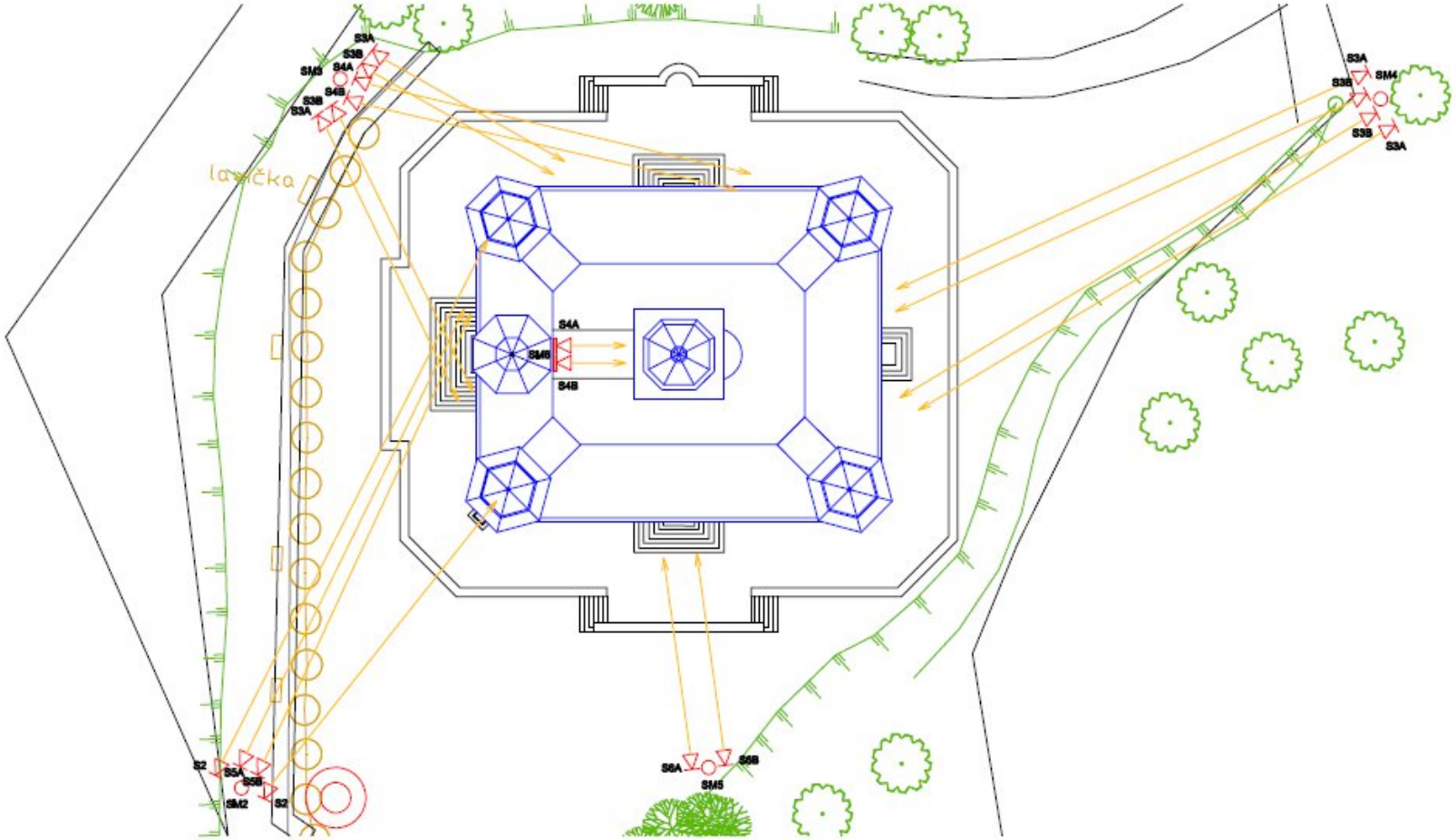

jižní fasáda

severní fasáda


lavička
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SM3
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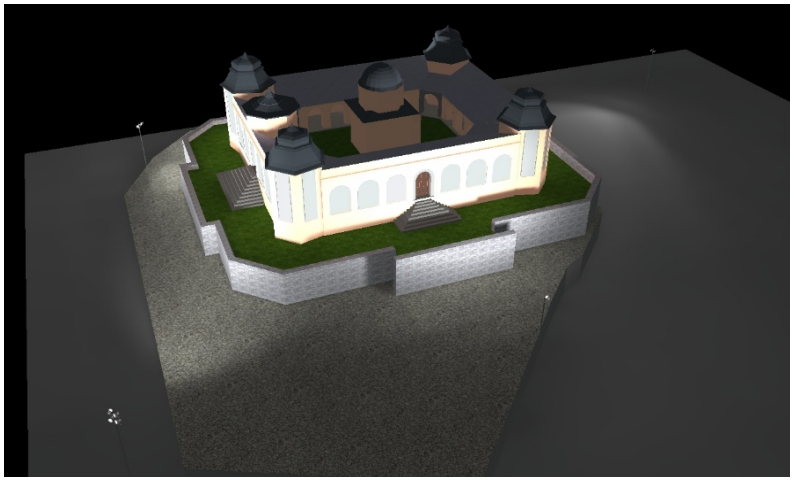
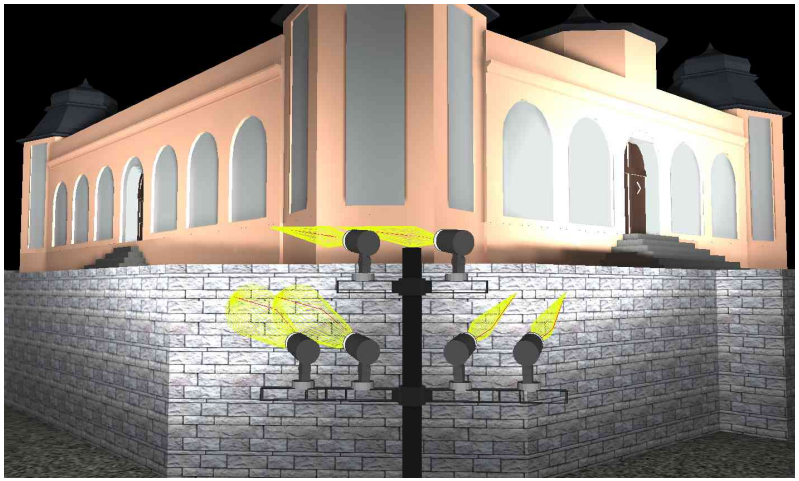
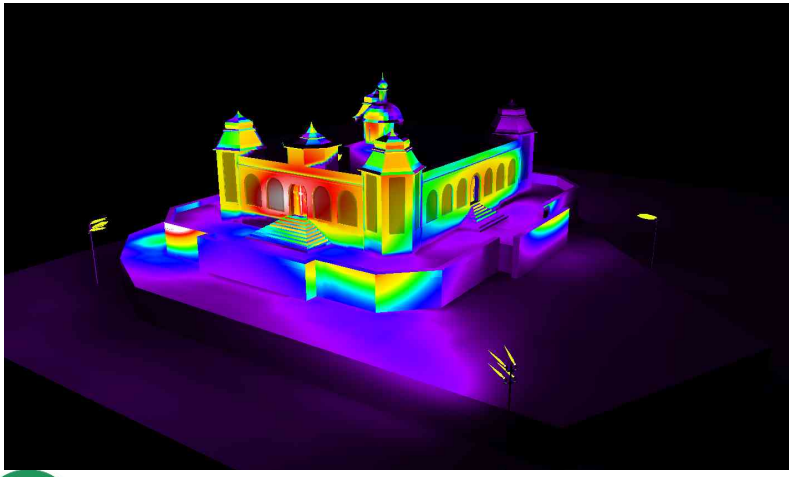
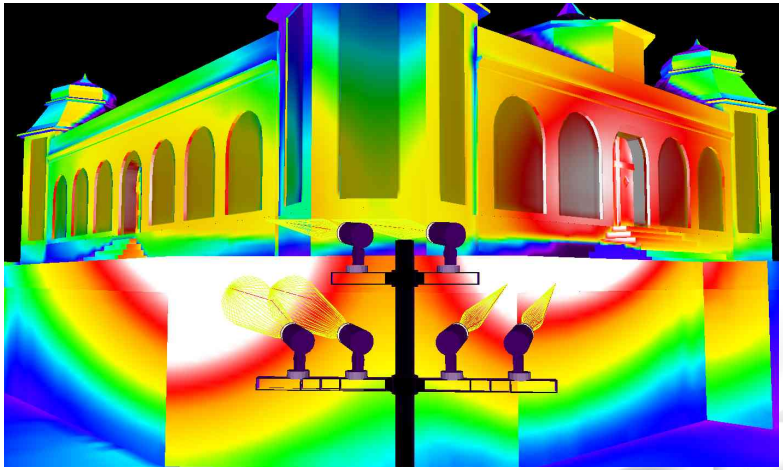
# DYNAMIC LIGHT

## TOWARDS DYNAMIC, INTELLIGENT AND ENERGY EFFICIENT URBAN LIGHTING









# Thanks for your attention

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