



**15. SLOVENSKI
KONGRES**

**O PROMETU
IN PROMETNI
INFRASTRUKTURI**

ZAG

Koncept vpeljave rezultatov spremljanja stanja v BIM model prometne infrastrukture

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Kazalo predstavitve

- Uvod
- Podatkovni slovar
- Ontologija
- Programski vmesnik
- Testni primer
- Zaključki



Uvod (1/2)

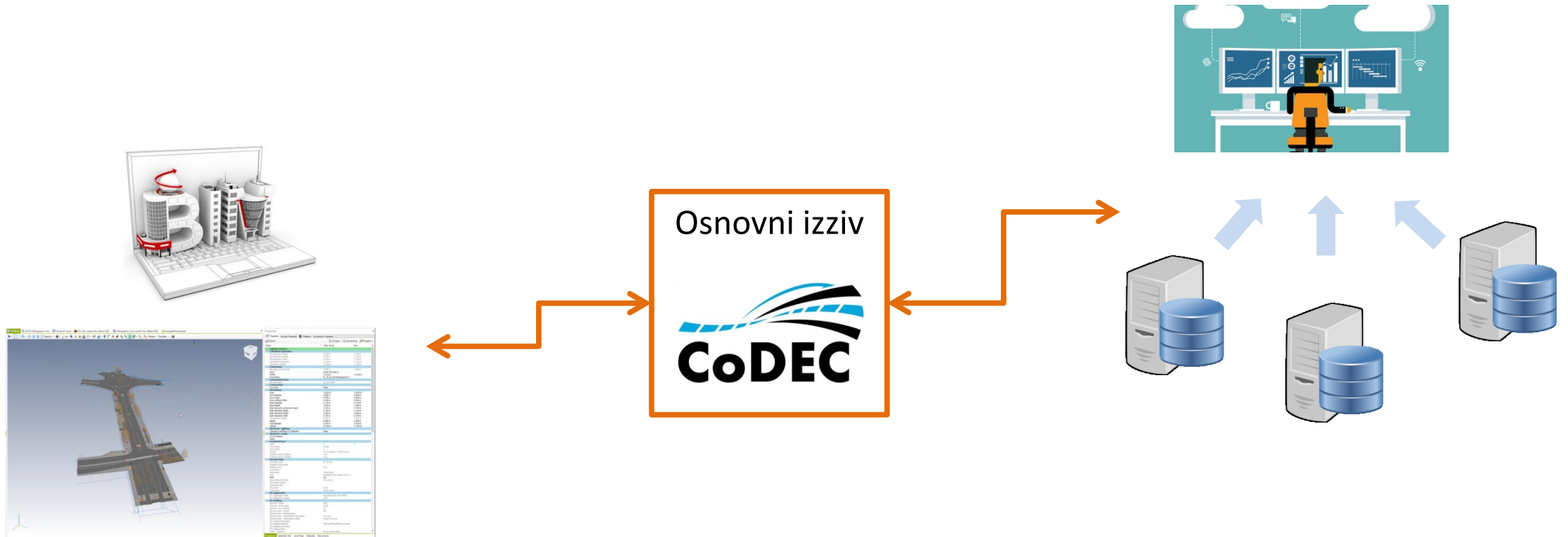
BIM pristop in prometna infrastruktura:

- izboljšano sodelovanje med deležniki in izmenjava informacij
- za namene upravljanja v zaostanku glede na ostale panoge
- BIM zaenkrat ne podpira podatkov v operativni fazi
- slaba podpora rezultatov novih tehnologij

Učinkovito upravljanje zahteva:

- dostop, prenos in integracijo podatkov iz različnih virov
- zmožnost vključitve velikih količin kompleksnih podatkov
- vzpostavitev povezave med BIM in AMS (že dobro vpeljani)

Uvod (2/2)



Podatkovni slovar (1/3)

Pripravljen na osnovi:

- Pregleda literature in vrste podatkov, ki jih zbirajo cestne uprave
- Rezultatov spletne ankete ter mnenj strokovnjakov cestnih uprav

Podatkovni slovar (PS) CoDEC vključuje:

- PS za predore in premostitvene objekte
- PS [Highways England](#) UK-ADMM

Podatkovni slovar (2/3)

Podatkovni slovar (PS) CoDEC vključuje še:

- Data Standard for Road Management and Investment ([AUS+NZ](#))
- [ifcRoad](#)

PS CoDEC sestavljajo podatki o:

- Inventarju prometne infrastrukture
- Senzorjih oz. tehnologijah za spremljanje stanja (statični in dinamični/mobilni)

Podatkovni slovar (3/3)

Izveček iz podatkovnega slovarja za vozišča in premostitvene objekte
 Izveček iz podatkovnega slovarja za merilni instrumentarij

This section defines the properties needed to describe Sensors

| Object Sub-Class | Property Type | Property Name |
|------------------------|---------------|-----------------------------|
| Fixed-location sensors | Classifiers | Altitude (End) |
| Mobile sensors | Identifiers | Altitude (Start) |
| (blank) | Location | Array/Network description |
| | | Array/Network ID |
| | | Array/Network name |
| | | Asset type |
| | | Asset type(s) |
| | | Component type |
| | | Coordinate reference system |

| Object Class | Object Sub-Class | Property Type | Property Name | Property Definition | Data Requirement | Formats | Unit (type) | Const |
|------------------------------------|------------------------|---------------|-----------------------------|--|------------------|---------|-------------|-------|
| Monitoring and surveying equipment | Fixed-location sensors | Identifiers | Array/Network ID | Unique sensor array/network ID | Conditional | String | | |
| Monitoring and surveying equipment | Fixed-location sensors | Identifiers | Array/Network name | A meaningful name for the sensor array/network | | String | | |
| Monitoring and surveying equipment | Fixed-location sensors | Identifiers | Array/Network description | Plain-text description of the sensor array/network | | String | | |
| Monitoring and surveying equipment | Fixed-location sensors | Identifiers | Sensor ID | Unique sensor ID | Mandatory | String | | |
| Monitoring and surveying equipment | Fixed-location sensors | Identifiers | Sensor Name | A meaningful name for the sensor | | String | | |
| Monitoring and surveying equipment | Fixed-location sensors | Identifiers | Sensor Description | Plain-text description of the sensor | | String | | |
| Monitoring and surveying equipment | Fixed-location sensors | Identifiers | Manufacturer | The name of the manufacturer of the sensor | | String | | |
| Monitoring and surveying equipment | Fixed-location sensors | Classifiers | Sensor Class | Class of sensor | | String | | List |
| Monitoring and surveying equipment | Fixed-location sensors | Classifiers | Sensor Type | Type of sensor (more specific than class) | | String | | List |
| Monitoring and surveying equipment | Fixed-location sensors | Classifiers | Intended Application | Description of the intended application (use) of the sensor | | String | | |
| Monitoring and surveying equipment | Fixed-location sensors | Classifiers | Sensor Standard(s) | Standard(s) relevant to the sensor type | | String | | |
| Monitoring and surveying equipment | Fixed-location sensors | Classifiers | Asset type(s) | The type(s) of asset for which the data is collected | | String | | List |
| Monitoring and surveying equipment | Fixed-location sensors | Location | Coordinate reference system | Name/ID for the coordinate reference system used | | String | | List |
| Monitoring and surveying equipment | Fixed-location sensors | Location | Latitude (Start) | Easting coordinate of start point | Conditional | Decimal | | |
| Monitoring and surveying equipment | Fixed-location sensors | Location | Longitude (Start) | Northing coordinate of start point | Conditional | Decimal | | |
| Monitoring and surveying equipment | Fixed-location sensors | Location | Altitude (Start) | Altitude of start point | | Decimal | | |
| Monitoring and surveying equipment | Fixed-location sensors | Location | Latitude (End) | Easting coordinate of end point | Conditional | Decimal | | |
| Monitoring and surveying equipment | Fixed-location sensors | Location | Longitude (End) | Northing coordinate of end point | Conditional | Decimal | | |
| Monitoring and surveying equipment | Fixed-location sensors | Location | Altitude (End) | Altitude of end point | | Decimal | | |
| Monitoring and surveying equipment | Fixed-location sensors | Location | Section ref. label | Unique ID of the network section to which the sensor is associated for the purposes of network location referencing | Conditional | String | | |
| Monitoring and surveying equipment | Fixed-location sensors | Location | Lane | Lane of the section to which the sensor is associated for the purposes of network location referencing | Conditional | String | | |
| Monitoring and surveying equipment | Fixed-location sensors | Location | Start chainage | The along carriageway position corresponding to the beginning of a linear or polygon asset, as measured within the section | Conditional | Decimal | Distance | |
| Monitoring and surveying equipment | Fixed-location sensors | Location | End chainage | The along carriageway position corresponding to the termination of a linear or polygon asset, as measured within the section | Conditional | Decimal | Distance | |
| Monitoring and surveying equipment | Fixed-location sensors | Location | Offset (section centreline) | Lateral position defined by numerical offset from the section centreline | | Decimal | Distance | |

Navigation: Title Page | Data Dictionary Structure | Entities and Elements | Sensors | Sensor Data | Example of Dynamic Data set | FAQs

| | | | | | | |
|---------------|--------------|---------------|------------|----------|--------------|---|
| Road entities | Carriageways | Road sections | Road studs | Physical | Commissioner | Name of the responsible for the commissioning of the road studs |
|---------------|--------------|---------------|------------|----------|--------------|---|

Ontologija (1/2)

Ontologija vsebuje opis konceptov in relacij med podatki o elementih prometne infrastrukture in je zasnovana na:

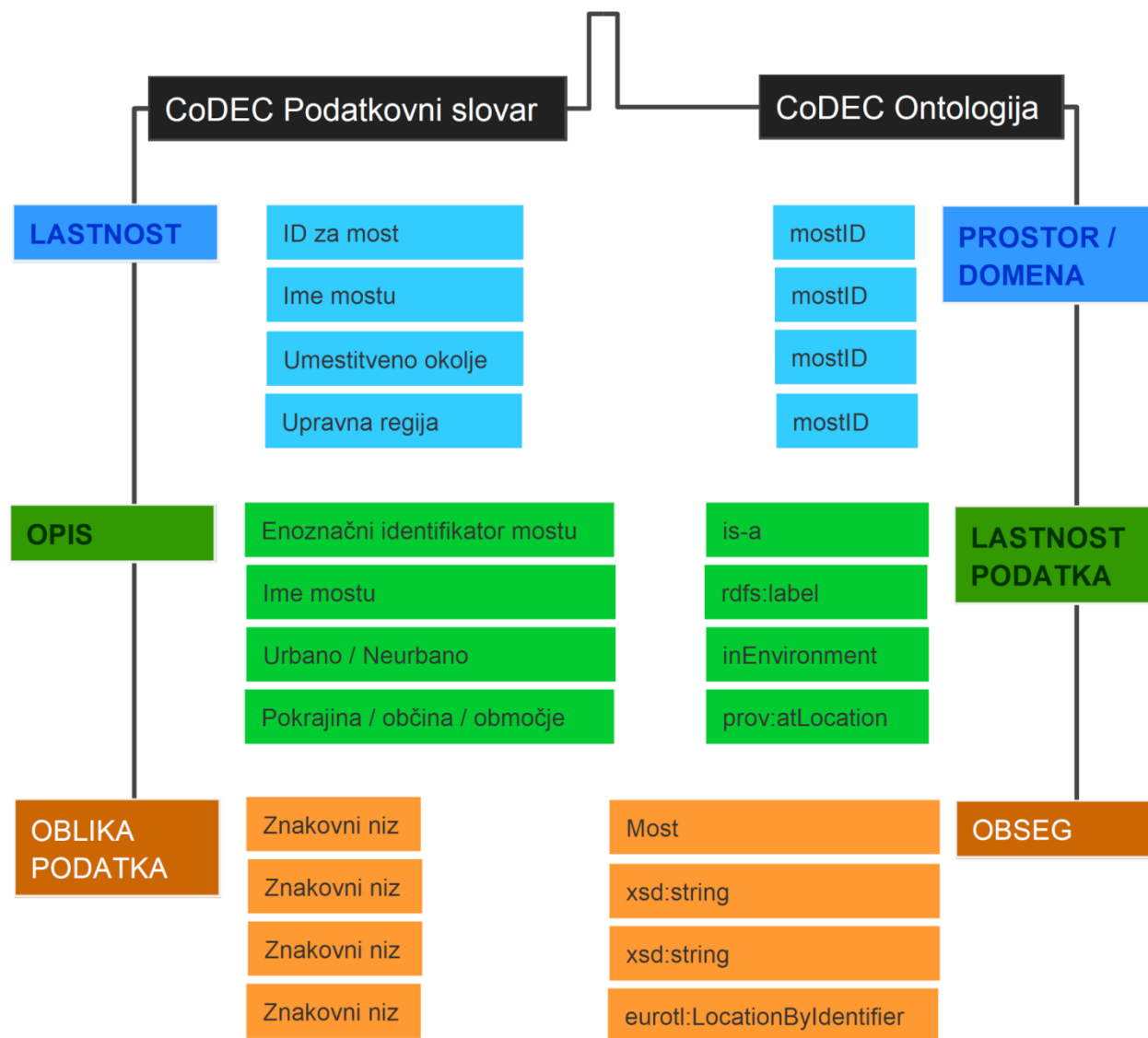
- knjižnici **EUROTL**
- tehnologiji **semantičnega spleta** (Semantic Web)
- tehnologiji **povezanih podatkov** (Linked Data)

Ontologija CoDEC je razvita z uporabo **RDF** in **OWL**.

Ontologija (2/2)

Dopolnitev knjižnice **EUROTL** z novimi razredi, podrazredi in lastnostmi

Uporaba odprtokodnega orodja za urejanje ontologij **Protege**



Programski vmesnik

Programski vmesnik (API) je sklop jasno opredeljenih komunikacijskih protokolov, ki podpirajo iskanje podatkov v različnih virih z uporabo povezanih podatkov in tehnologije semantičnega spleta.

Vmesnik CoDEC API predstavlja tehnično rešitev povezave med BIM in AMS, ki omogoča:

- kateri koli programski rešitvi dostop do okolja povezanih podatkov
- da se ontologija razvija neodvisno od programskega okolja
- da podatke lahko uporablja katera koli programska rešitev, ne da bi poznali podrobnosti povezav

CoDEC API se torej lahko uporablja v kateri koli programski opremi (potrebujemo pa orodje za vizualizacijo, Bexel Manager)

Testni primer (1/3)

Za testni primer so bili uporabljeni podatki projekta INTERLINK (podatki o javni cestni razsvetljavi).

Osnovni namen testnega primera je bil:

- preveriti dostop in prenos podatkov v okolje BIM s pomočjo povezanih podatkov in semantičnega spleta
- vzdrževalcem zagotoviti informacije o stanju svetilk v BIM okolju

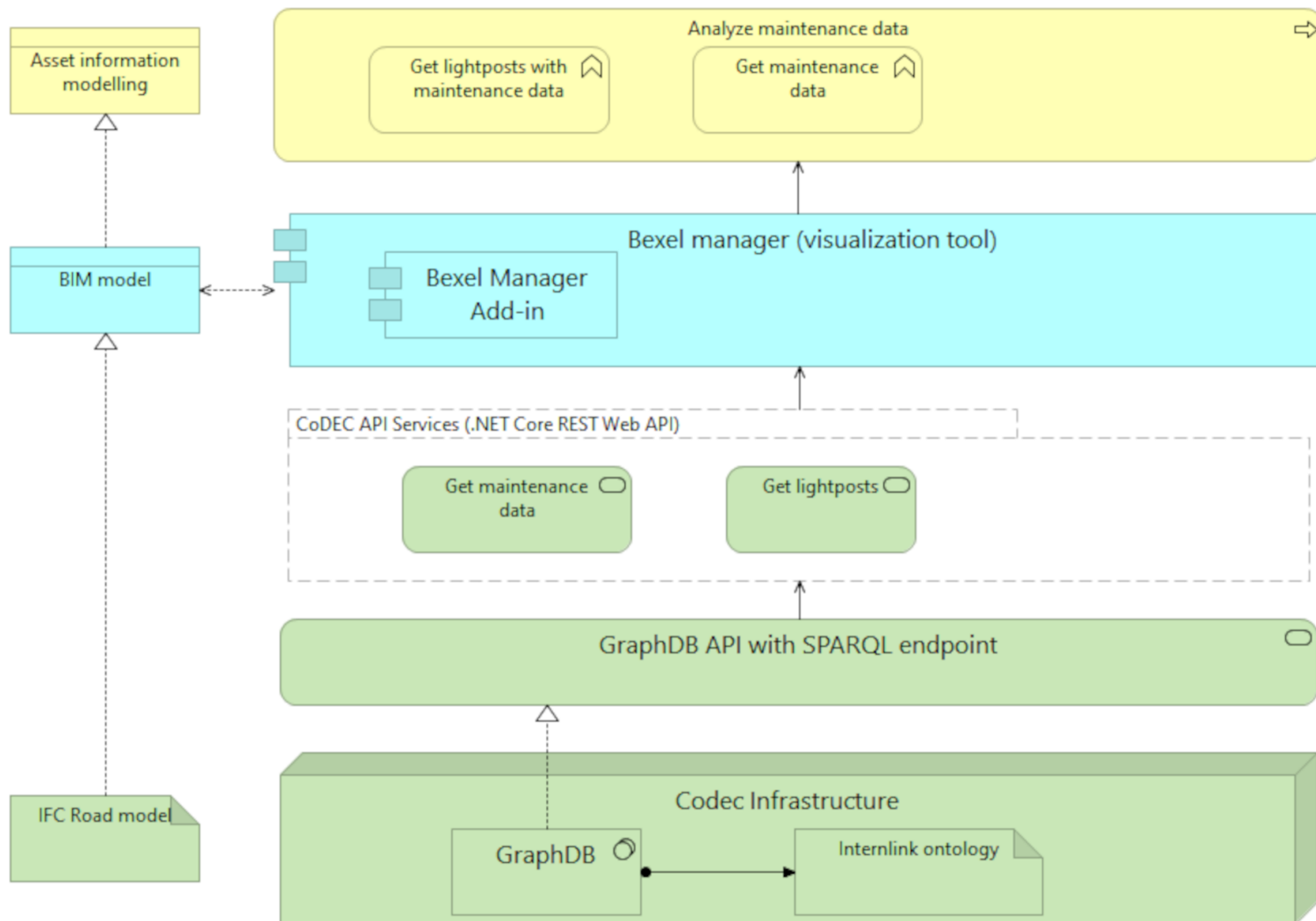
Za vizualizacijo BIM modela je bil uporabljen Bexel Manager.

Testni primer (2/3)

Shematski diagram delovanja testnega primera

CoDEC API:

- Get maintenance data
- Get lightposts



Testni primer (3/3)

Bexel Manager – prikaz BIM modela uličnih svetilk ter podatkov o njihovem vzdrževanju

The screenshot displays the Bexel Manager interface. The central 3D view shows a street scene with several streetlights and traffic signals. A 'Linked Data' window is open on the left, showing a tree structure of data for a selected light fixture. The data includes:

- IssueDescription:** type: literal, value: Broken light in light pole. The fixture seems to be in order.
- LightID:** type: uri, value: http://areal.nrs.nl/82af6b27e04745dc70381a973c99e4541baedf
- MaintenanceID:** type: literal, value: Replace light
- IssueDate:** datatype: http://www.w3.org/2001/XMLSchema#date, type: literal, value: 2017-07-08
- IssueID:** type: uri, value: http://cedr.semtech.com/dutch/ha/datasets/A16-surveys/Issue_1.5.10.2017
- MaintenanceDate:** type: literal, value: http://cedr.semtech.com/dutch/ha/datasets/A16-maintenance/Sun-Jul-19-00:3A00:3A00-CEST-2017
- MaintenanceType:** type: uri, value: http://cedr.semtech.com/dutch/ha/datasets/A16-maintenance/Repair

On the right, the 'Properties' window shows a table of calculated quantities and constraints for the selected light fixture:

| Name | Value (Avg) | Sum |
|--|--|----------------------|
| Lighting Fixtures | | |
| Calculated Quantities | | |
| Bounding Box Height | 6.219 m | 6.219 m |
| Bounding Box Length | 0.726 m | 0.726 m |
| Bounding Box Width | 0.762 m | 0.762 m |
| Calculated Gross Area | 3.132 m ² | 3.132 m ² |
| Calculated Volume | 0.108 m ³ | 0.108 m ³ |
| Constraints | | |
| Elevation (Constraints) | 0.980 m | 0.980 m |
| Level | Level: 00 Level_0 | |
| Offset | -0.010 m | |
| Work Plane | Pl_25_93_60-KerbAdaptive-Type1... | |
| Constraints (Type) | | |
| Elevation Base | Survey Point | |
| Construction | | |
| Two Arms | False | |
| Dimensions | | |
| Area | 1.923 m ² | 1.923 m ² |
| Arm Diameter | 0.060 m | 0.060 m |
| Arm Length | 0.070 m | 0.070 m |
| Arms vertical offset | 0.056 m | 0.056 m |
| Base Diameter | 0.170 m | 0.170 m |
| Base Height | 1.000 m | 1.000 m |
| Base/top post connection height | 4.345 m | 4.345 m |
| Bulb casement height | 0.150 m | 0.150 m |
| Bulb casement length | 0.650 m | 0.650 m |
| Bulb casement width | 0.370 m | 0.370 m |
| Construction Height | 0.200 m | 0.200 m |
| Height | 6.200 m | 6.200 m |
| Top Diameter | 0.070 m | 0.070 m |
| Volume | 0.109 m ³ | 0.109 m ³ |
| Electrical - Lighting | | |
| Calculate Coefficient of Utilization | False | |
| Electrical - Loads | | |
| Circuit Number | | |
| Panel | | |
| Graphics (Type) | | |
| Color | 0 | 0 |
| Line Pattern | Center | |
| Line Weight | 1 | |
| Symbol | M_Level Head - Circle: M_Level Hea... | |
| Symbol at End 1 Default | True | |
| Symbol at End 2 Default | True | |
| Identity Data | | |
| Assembly Code | EP_70_80 | |
| Assembly Description | | |
| Building Storey | True | |
| Code Name | | |
| Description | Street Light | |
| Guid | 82af6b27e04745dc70381a973c99e4541baedf | |
| Mark | 223 | |
| Name (Identity Data) | 00 Level_0 | |
| OverClass Number | | |
| OverClass Title | | |
| Structural | False | |
| Type Name | Street Light | |
| IFC Application | | |
| IFC Application Name | Autodesk Revit 2019 (ENG) | |
| IFC Application Version | 2019 | |
| IFC Building | | |
| General - Building | COB | |
| General - Grid System | OSGB | |
| General - Surveyed By | AT | |
| Identity Data - Author | MSL | |
| Identity Data - Building Name | | |
| Identity Data - Organization Description | Surveyor | |
| Identity Data - Organization Name | Murphy Surveys | |
| IFC Building Description | | |
| IFC Building Global ID | 28e4d0d842b6d8f8f8e4e... | |
| IFC Building Long Name | | |
| IFC Building Name | | |
| Other - Category | Project Information | |

Zaključki (1/2)

- Projekt CoDEC predstavlja enega prvih poskusov uporabe BIM za namene **upravljanja** s cestnim premoženjem.
- PS in ontologija prometne infrastrukture omogočata vzpostavitev **skupne uporabnosti** med BIM in AMS okoljema.
- Prvi korak v smeri izdelave digitalnih dvojčkov prometne infrastrukture, ki morajo vsebovati podatke o **stanju infrastrukture**.

Zaključki (2/2)

- Izzivi za nadaljnje delo (učinkovitost upravljanja s cestnim premoženjem):
 - več sodelovanja med vsemi vključenimi subjekti,
 - neustrezna stopnja detajlov BIM modelov za potrebe upravljanja,
 - malo standardiziranih procesov med BIM in AMS programskimi okolji,
 - nizka stopnja avtomatizacije procesov, tako v BIM kot tudi v AMS okolju.
- Ključno vlogo igrajo ažurni vhodni podatki.

Hvala za pozornost!



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