# 3D City Database for CityGML

## 3D City Database Version 2.0.6-postgis

## Importer/Exporter Version 1.4.0-postgis

***beta* version**

**Port documentation: Java**

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**Geoinformation Research Group**
**Department of Geography**
**University of Potsdam**

Felix Kunde
Hartmut Asche

**Institute for Geodesy and**
**Geoinformation Science**
**Technische Universität Berlin**

Thomas H. Kolbe
Claus Nagel
Javier Herreruela
Gerhard König

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## Content:

Welcome to the documentation about ported java-classes for the *PostGIS* version of the *Importer/Exporter* tool. This document only shows exemplary parts of classes that hold database-specific Java code. Even though they are of a large number the software works mostly database-independant and had not been changed too much in the end. This documentation is devided into thematic parts and not in software-packages. Infoboxes at the start of each chapter should provide a quick overview which classes had to be changed and which packages were affected by this.

# 0. Legend

## Packages:

| | |
|---|---|
| ⬜ api | = no classes in this package were changed |
| 🟨 database | = some parts of this package were changed |
| 🟧 modules | = package contains parts which need to be translated in the future |

## Location of classes:

| | | | |
|---|---|---|---|
| [A] | from package api | [M cityC] | modules.citygml.common |
| [Cmd] | cmd | [M cityE] | modules.citygml.exporter |
| [C] | config | [M cityI] | modules.citygml.importer |
| [D] | database | [M com] | modules.common |
| [E] | event | [M db] | modules.database |
| [G] | gui | [M kml] | modules.kml |
| [L] | log | [M pref] | modules.prefrences |
| [P] | plugin | [oracle] | oracle.spatial.geometry |
| [U] | util | | |

## Code:

| | |
|---|---|
| 59 | changes start at line 59 in the corresponding class |
| 115+ | these lines could not be translated but were also not neccessary in function |
| **rep** | this code-example is repeating itself in the same class |
| **rep+** | this code-example is repeating itself in the same class and in other classes |
| `//private Integer port = 1521;` | uncommented *Oracle*-specific code (already deleted from the classes) |
| `private Integer port = 5432;` | *PostGIS*-specific code |

# 1. Connection to the Database

| Packages: | |
|---|---|
| ⬜ | api |
| 🟧 | cmd |
| 🟨 | config |
| 🟨 | database |
| ⬜ | event |
| 🟧 | gui |
| ⬜ | log |
| 🟧 | modules |
| 🟧 | plugin |
| 🟧 | util |

| Classes: | |
|---|---|
| [Cmd] | ImpExpCmd |
| [C] | DBConnection |
| [D] | DatabaseConnectionPool |
| [D] | DatabaseControllerImpl |
| [M cityC] | BranchTemporaryCacheTable |
| [M cityC] | CacheManager |
| [M cityC] | HeapCacheTable |
| [M cityC] | TemporaryCacheTable |
| [M cityE] | DBExportWorker |
| [M cityE] | DBExportWorkerFactory |
| [M cityE] | DBXlinkWorker |
| [M cityE] | DBXlinkWorkerFactory |
| [M cityE] | Exporter |
| [M cityE] | DBSplitter |
| [M cityE] | ExportPanel |
| [M cityI] | DBImportWorker |
| [M cityI] | DBImportWorkerFactory |
| [M cityI] | DBImportXlinkResolverWorker |
| [M cityI] | DBImportXlinkResolverWorkerFactory |
| [M cityI] | Importer |
| [M cityI] | DBCityObject |
| [M cityI] | DBStGeometry |
| [M cityi] | DBSurfaceData |
| [M cityi] | DBSurfaceGeometry |
| [M cityi] | XlinkWorldFile |
| [M cityi] | ImportPanel |
| [M com] | BoundingBoxFilter |
| [M db] | SrsPanel |
| [G] | ImpExpGui |
| [G] | SrsComboBoxFactory |
| [P] | llegalPluginEventChecker |
| [U] | DBUtil |

Connection handling has not changed much for the *PostgreSQL* database only because the *Universal Connection Pool (UCP)* by Oracle is still used. The `PoolDataSource` of the *UCP* must pool a proper DataSource of *PostgreSQL* (`PGSimpleDataSource`). It was necessary to set the database-name separately. The method `conn.getSid()` fetches the right value of the according text-field but can not interpret it internally. Obviously that is because of the different definitions about the database itself between *Oracle* and *PostgreSQL*. To work within a network the server-name and the port-number have to be set as well. The URL which usually addresses the JDBC driver of a DBMS, could be left out. Connection-properties were uncommented as the `PGconnection` class of *PostgreSQL* only holds the same attributes than the Java `Connection` class. `CONNECTION_PROPERTY_USE_THREADLOCAL_BUFFER_CACHE` was not offered.

Unfortunately the use of Oracle’s *UCP* is not conform to the OpenSource effort behind the *PostGIS* version of the *3DCityDB*. The Apache *Jakarta DBCP* was tested by the developers but found to work unacceptably worse than the *UCP*. The Connection Pools of Apache’s *Tomcat 7* or *C3PO* should be an alternative. As seen by the number of orange packages in the overview-box, this means a lot of code rework.

de.tub.citydb.config.project.database.**DBConnection**

```
59    //private Integer port = 1521;
      private Integer port = 5432;
```

de.tub.citydb.database.**DatabaseConnectionPool**

```
59    //private final String poolName = "oracle.pool";
      private final String poolName = "postgresql.pool";

109   // poolDataSource.setConnectionFactoryClassName(
      //    "oracle.jdbc.pool.OracleDataSource");
      poolDataSource.setConnectionFactoryClassName(
            "org.postgresql.ds.PGSimpleDataSource");

110   poolDataSource.setDatabaseName(conn.getSid());

111   // poolDataSource.setURL("jdbc:oracle:thin:@//" + conn.getServer() + ":" +
            conn.getPort()+ "/" + conn.getSid());
      poolDataSource.setURL("jdbc:postgresql://" + conn.getServer() + ":" +
            conn.getPort() + "/" + conn.getSid());
```

or:

```
      poolDataSource.setServerName(conn.getServer());
      poolDataSource.setPortNumber(conn.getPort());

115+  // set connection properties
```

## 2. Calling the PL/pgSQL-functions

Packages:

- ☐ api
- ☐ cmd
- ☐ config
- ☐ database
- ☐ event
- ☐ gui
- ☐ log
- 🟨 modules
- ☐ plugin
- 🟨 util

Classes:

| | |
|---|---|
| [M db] | IndexOperation |
| [M cityI] | Importer |
| [M cityE] | DBAppearance |
| [M cityE] | DBBuilding |
| [M cityE] | DBBuildingFurniture |
| [M cityE] | DBCityFurniture |
| [M cityE] | DBCityObject |
| [M cityE] | DBCityObjectGroup |
| [M cityE] | DBGeneralization |
| [M cityE] | DBGenericCityObject |
| [M cityE] | DBReliefFeature |
| [M cityE] | DBSolitaryVegetatObject |
| [M cityE] | DBSurfaceGeometry |
| [M cityE] | DBThematicSurface |
| [M cityE] | DBTransportationComplex |
| [M cityE] | DBWaterBody |
| [U] | DBUtil |

Most of the functionalities in the database panel of the *Importer/Exporter* are calling stored procedures in the database. So the main changes in code were done in the PL/pgSQL scripts. Within Java only the names of the called functions were changed. The functions are bundled inside of a database-schema called "geodb_pkg".

## 2.1 index-functions, database-report, utility-functions inside of statements

The bigger the size of files to be imported the longer it takes to index the data after every inserted tuple. Therefore indexes are dropped and recreated after the import. *Oracle* keeps metadata of a dropped index, *PostgreSQL* does not. An alternative way was programmed but it is not used now. It was the idea to just set the index-status to invalid (pg_index.indisvalid) that it stays inactive during the import and then REINDEX it afterwards. It was only tested with small datasets but no performance improvement could be detected. The functions are already written but they are not a part of the recent release.

für alle de.tub.citydb.modules.citygml.exporter.database.content.**DB***

```
//geodb_util.transform_or_null(...
geodb_pkg.util_transform_or_null(...
```

de.tub.citydb.util.database.**DBUtil**

```
73     // private static OracleCallableStatement callableStmt;
       private static CallableStatement callableStmt;

91     // rs = stmt.executeQuery("select * from table(geodb_util.db_metadata)");
       rs = stmt.executeQuery("select * from geodb_pkg.util_db_metadata() as t");

199    // callableStmt = (OracleCallableStatement)conn.prepareCall("{? = call
rep    //      geodb_stat.table_contents}");
       callableStmt = (CallableStatement)conn.prepareCall("{? = call
             geodb_pkg.stat_table_contents()}");

200    // callableStmt.registerOutParameter(1, OracleTypes.ARRAY, "STRARRAY");
rep    callableStmt.registerOutParameter(1, Types.ARRAY);

203    // ARRAY result = callableStmt.getARRAY(1);
rep    Array result = callableStmt.getArray(1);

374    // String call = type == DBIndexType.SPATIAL ?
rep    //            "{? = call geodb_idx.drop_spatial_indexes}" :
       //                  "{? = call geodb_idx.drop_normal_indexes}";
       Drop Case:
       String call = type == DBIndexType.SPATIAL ?
             "{? = call geodb_pkg.idx_drop_spatial_indexes()}" :
                   "{? = call geodb_pkg.idx_drop_normal_indexes()}";
       or Switch-Case:
       String call = type == DBIndexType.SPATIAL ?
             "{? = call geodb_pkg.idx_switch_off_spatial_indexes()}" :
                   "{? = call geodb_pkg.idx_switch_off_normal_indexes()}";
       // callableStmt = (OracleCallableStatement)conn.prepareCall(call);
       callableStmt = (CallableStatement)conn.prepareCall(call);
```

## 2.2 Calculation of the BoundingBox

For the calculation of the BoundingBox workspace-variables were uncommented. The query strings had to call equivalent *PostGIS* functions (e.g. `sdo_aggr_mbr --> ST_Extent`, `geodb_util.to2d --> ST_Force_2d`). As rectangle geometries can not be shorten in number of points like in *Oracle* (LLB, URT), 5 Points were needed for the coordinate-transformation. As placeholders for single coordinates did not work with a `PreparedStatement` the whole String in the PostGIS function ST_GeomFromEWKT(?) was used as the exchangeable variable.

de.tub.citydb.util.database.**DBUtil**

```
237   // public static BoundingBox calcBoundingBox(Workspace workspace,
      //    FeatureClassMode featureClass) throws SQLException {
      public static BoundingBox calcBoundingBox(FeatureClassMode featureClass)
            throws SQLException {


248   // String query = "select sdo_aggr_mbr(geodb_util.to_2d(
      //    ENVELOPE, (select srid from database_srs)))
      //          from CITYOBJECT where ENVELOPE is not NULL";
      String query = "select ST_Extent(ST_Force_2d(envelope))::geometry
            from cityobject where envelope is not null";

317   // double[] points = jGeom.getOrdinatesArray();
      // if (dim == 2) {
      //    xmin = points[0];
      //    ymin = points[1];
      //    xmax = points[2];
      //    ymax = points[3];
      // } else if (dim == 3) {
      //    xmin = points[0];
      //    ymin = points[1];
      //    xmax = points[3];
      //    ymax = points[4];
      // }
      xmin = (geom.getPoint(0).x);
      ymin = (geom.getPoint(0).y);
      xmax = (geom.getPoint(2).x);
      ymax = (geom.getPoint(2).y);

629   // psQuery = conn.prepareStatement("select SDO_CS.TRANSFORM(
      //    MDSYS.SDO_GEOMETRY(2003, " + sourceSrid + ", NULL,
      //    MDSYS.SDO_ELEM_INFO_ARRAY(1, 1003, 1), " +
      //    "MDSYS.SDO_ORDINATE_ARRAY(?,?,?,?)), " + targetSrid + ")from dual");
      // psQuery.setDouble(1, bbox.getLowerLeftCorner().getX());
      // psQuery.setDouble(2, bbox.getLowerLeftCorner().getY());
      // psQuery.setDouble(3, bbox.getUpperRightCorner().getX());
      // psQuery.setDouble(4, bbox.getUpperRightCorner().getY());
      psQuery = conn.prepareStatement("select ST_Transform(ST_GeomFromEWKT(?), "
            + targetSrid + ")");

      boxGeom = "SRID=" + sourceSrid + ";POLYGON((" +
            bbox.getLowerLeftCorner().getX() + " " +
            bbox.getLowerLeftCorner().getY() + "," +
            bbox.getLowerLeftCorner().getX() + " " +
            bbox.getUpperRightCorner().getY() + "," +
            bbox.getUpperRightCorner().getX() + " " +
            bbox.getUpperRightCorner().getY() + "," +
            bbox.getUpperRightCorner().getX() + " " +
            bbox.getLowerLeftCorner().getY() + "," +
            bbox.getLowerLeftCorner().getX() + " " +
            bbox.getLowerLeftCorner().getY() + "))";

      psQuery.setString(1, boxGeom);

      // double[] ordinatesArray = geom.getOrdinatesArray();
      // result.getLowerCorner().setX(ordinatesArray[0]);
      // result.getLowerCorner().setY(ordinatesArray[1]);
      // result.getUpperCorner().setX(ordinatesArray[2]);
      // result.getUpperCorner().setY(ordinatesArray[3]);
      result.getLowerLeftCorner().setX(geom.getPoint(0).x);
      result.getLowerLeftCorner().setY(geom.getPoint(0).y);
      result.getUpperRightCorner().setX(geom.getPoint(2).x);
      result.getUpperRightCorner().setY(geom.getPoint(2).y);
```

# 3. Statement-Strings and database-SRS

Packages:

- 🟨 api
- ☐ cmd
- ☐ config
- ☐ database
- ☐ event
- 🟨 gui
- ☐ log
- 🟨 modules
- ☐ plugin
- 🟨 util

Classes:

| | |
|---|---|
| [A] | DatabaseSrsType |
| [A] | DatabaseSrs |
| [G] | SrsComboBoxFactory |
| [M cityC] | CacheTableBasic |
| [M cityC] | CacheTableDeprecatedMaterial |
| [M cityC] | CacheTableGlobalAppearance |
| [M cityC] | CacheTableGmlId |
| [M cityC] | CacheTableGroupToCityObject |
| [M cityC] | CacheTableLiberaryObject |
| [M cityC] | CacheTableSurfaceGeometry |
| [M cityC] | CacheTableTextureAssociation |
| [M cityC] | CacheTableTextureFile |
| [M cityC] | CacheTableTextureParam |
| [M cityC] | CacheTableModel |
| [M cityC] | HeapCacheTable |
| [M cityE] | Exporter |
| [M cityE] | DBAppearance |
| [M cityE] | DBSplitter |
| [M cityI] | DBCityObject |
| [M cityI] | DBCityObjectGenericAttrib |
| [M cityI] | DBExternalReference |
| [M cityI] | DBSequencer |
| [M cityI] | DBSurfaceGeometry |
| [M cityI] | XlinkSurfaceGeometry |
| [U] | DBUtil |

## 3.1 The database-SRS

Until now *PostGIS* does not offer 3D-spatial-reference-systems by default. INSERT examples for *PostGIS* can be found at spatialreference.org. Unfortunately 2D and 3D geographic reference systems are equally classified as GEOGCS. The function is3D would not detect 3D-SRIDs though. A trick might be to change the INSERT-statement by spatialreference.org from GEOGCS to GEOGCS3D. Then is3D() would work as the type is listed in the DatabaseSrsType class. It is not sure how 3D-SRIDs will be handled in future *PostGIS* releases. *Oracle Spatial* has got some strict rules how to work with them. This includes certain checks on the data, which are not needed for the *PostGIS* version at the moment. It can be noticed that the spatial_ref_sys table in *PostGIS* contains less columns than *Oracle*'s SDO_COORD_REF_SYS-table. Most of the information is stored in the text-column srtext. It can be extracted with String-functions but it is a kind of ugly way.

de.tub.citydb.api.database.**DatabaseSrsType**

```
PROJECTED("PROJCS", "Projected"),
GEOGRAPHIC2D("GEOGCS", "Geographic2D"),
GEOCENTRIC("GEOCCS", "Geocentric"),
VERTICAL("VERT_CS", "Vertical"),
ENGINEERING("LOCAL_CS", "Engineering"),
COMPOUND("COMPD_CS", "Compound"),
GEOGENTRIC("n/a", "Geogentric"),
GEOGRAPHIC3D("GEOGCS3D", "Geographic3D"),
UNKNOWN("", "n/a");
```

de.tub.citydb.util.database.**DBUtil**

```
141   // psQuery = conn.prepareStatement("select coord_ref_sys_name,
      //    coord_ref_sys_kind from sdo_coord_ref_sys where srid = ?");
      psQuery = conn.prepareStatement("select split_part(srtext, '\"', 2) as
            coord_ref_sys_name, split_part(srtext, '[', 1) as coord_ref_sys_kind
            FROM spatial_ref_sys WHERE SRID = ? ");

704   // psQuery = conn.prepareStatement(srs.getType() ==
      //    DatabaseSrsType.GEOGRAPHIC3D ?
      //    "select min(crs2d.srid) from sdo_coord_ref_sys crs3d,
      //    sdo_coord_ref_sys crs2d where crs3d.srid = " + srs.getSrid() +
      //    " and crs2d.coord_ref_sys_kind = 'GEOGRAPHIC2D'
      //    and crs3d.datum_id = crs2d.datum_id" :
      //          "select cmpd_horiz_srid from sdo_coord_ref_sys
      //          where srid = " + srs.getSrid());
      psQuery = conn.prepareStatement(srs.getType()== DatabaseSrsType.COMPOUND ?
       "select split_part((split_part(srtext,'AUTHORITY[\"EPSG\",\"',5)),'\"',1)
            from spatial_ref_sys where auth_srid = " + srs.getSrid() :
          // searching 2D equivalent for 3D SRID
       "select min(crs2d.auth_srid) from spatial_ref_sys crs3d, spatial_ref_sys
            crs2d where (crs3d.auth_srid = " + srs.getSrid() + " and split_part
                  (crs3d.srtext, '[', 1) LIKE 'GEOGCS' AND
                        split_part(crs2d.srtext, '[', 1) LIKE 'GEOGCS' " +
            //do they have the same Datum_ID?
            "and split_part(
                   (split_part(crs3d.srtext,'AUTHORITY[\"EPSG\",\"',3)),'\"',1)
            = split_part(
                  (split_part(crs2d.srtext,'AUTHORITY[\"EPSG\",\"',3)),'\"',1))
            OR " +
            // if srtext has been changed for Geographic3D
            "(crs3d.auth_srid = " + srs.getSrid() + " " and
                  split_part(crs3d.srtext, '[', 1) LIKE 'GEOGCS3D' AND
                        split_part(crs2d.srtext, '[', 1) LIKE 'GEOGCS' " +
            //do they have the same Datum_ID?
            "and split_part(
                  (split_part(crs3d.srtext,'AUTHORITY[\"EPSG\",\"',3)),'\"',1)
            = split_part(
                (split_part(crs2d.srtext,'AUTHORITY[\"EPSG\",\"',3)),'\"',1))");
```

## 3.2 BoundingBox-filter and OptimizerHints in DBSplitter.java

`DBSplitter.java` manages the filtering of data by a given bounding box. In *Oracle Spatial* the spatial operation SDO_RELATE is used for that. SDO_RELATE checks topological relations between geometries according to the 9-intersection Matrix (DE-9IM). It is possible to combine the mask-attributes with a logical OR (+). This is not adoptable for *PostGIS*, as the equivalent ST_Relate operation can only use one mask. Thus the first field of the bounding box fillter array contains four ST_Relate conditions connected by “or”.

Another feature of *Oracle* which is used in the `DBSplitter` class is the “Optimizer Hint”. It is used to tell the internal query-optimizer which query-plan to prefer. As there are no such Optimizer Hints in *PostgreSQL* they were uncommented.

de.tub.citydb.modules.citygml.exporter.database.content.**DBSplitter**

```
168   //    String filter = "SDO_RELATE(co.ENVELOPE, MDSYS.SDO_GEOMETRY(2003, "
      //          + bboxSrid + ", NULL, " +
      //          "MDSYS.SDO_ELEM_INFO_ARRAY(1, 1003, 3), " +
      //          "MDSYS.SDO_ORDINATE_ARRAY(" + minX + ", " + minY + ", " + maxX
      //          + ", " + maxY + ")), 'mask=";
      //          bboxFilter[0] = filter + "inside+coveredby') = 'TRUE'";
      //          bboxFilter[1] = filter + "equal') = 'TRUE'";
      //    if (overlap)
      //          bboxFilter[2] = filter + "overlapbdyintersect') = 'TRUE'";
      String filter = "ST_Relate(co.ENVELOPE, " +
                       "ST_GeomFromEWKT('SRID=" + bboxSrid + ";POLYGON((" +
                         minX + " " + minY + "," +
                         minX + " " + maxY + "," +
                         maxX + " " + maxY + "," +
                         maxX + " " + minY + "," +
                         minX + " " + minY + "))'), ";

      bboxFilter[0] = "(" + filter + "'T*F**F***') = 'TRUE' or " + // inside
                            filter + "'*TF**F***') = 'TRUE' or " + // coveredby
                            filter + "'**FT*F***') = 'TRUE' or " + // coveredby
                            filter + "'**F*TF***') = 'TRUE')"; // coveredby
      bboxFilter[1] = filter + "'T*F**FFF*') = 'TRUE'";     // equal

      if (overlap)
            bboxFilter[2] = filter + "'T*T***T**') = 'TRUE'"; //overlapbdyinter.
```

## 3.3 Query-statements for Import

Some queries of the Importer-classes use *Oracle*-specific functions.

de.tub.citydb.modules.citygml.exporter.database.content.**DBAppearance**

```
138   // nvl(sd.TEX_IMAGE.getContentLength(), 0) as DB_TEX_IMAGE_SIZE,
rep   // sd.TEX_IMAGE.getMimeType() as DB_TEX_IMAGE_MIME_TYPE, sd.TEX_MIME_TYPE,
      COALESCE(length(sd.TEX_IMAGE), 0) as DB_TEX_IMAGE_SIZE, sd.TEX_MIME_TYPE,
```

de.tub.citydb.modules.citygml.importer.database.content.**DBCityObject**

```
134   // SYSDATE
      now()
```

de.tub.citydb.modules.citygml.importer.database.content.**DBCityObjectGenericAttrib**

```
63    // CITYOBJECT_GENERICATT_SEQ.nextval
      nextval('CITYOBJECT_GENERICATTRIB_ID_SEQ')
```

de.tub.citydb.modules.citygml.importer.database.content.**DBExternalReference**

```
58    // EXTERNAL_REF_SEQ.nextval
```

```
      nextval('EXTERNAL_REFERENCE_ID_SEQ')
```

de.tub.citydb.modules.citygml.importer.database.content.**DBSequencer**

```
53    // pstsmt = conn.prepareStatement("select " + sequence.toString() +
            ".nextval from dual");
      pstsmt = conn.prepareStatement("select nextval('" + sequence.toString() +
            "')");
```

de.tub.citydb.modules.citygml.importer.database.content.**DBSurfaceGeometry**
de.tub.citydb.modules.citygml.importer.database.xlink.resolver.**XlinkSurfaceGeometry**

```
126   // SURFACE_GEOMETRY_SEQ.nextval
/98   nextval('SURFACE_GEOMETRY_ID_SEQ')
```

## 3.4 Create Table without "nologging"

There is no `nologging` option for CREATE statements in *PostgreSQL.*

de.tub.citydb.modules.citygml.common.database.cache.model.**CacheTableModel**

```
95    // " nologging" +
```

de.tub.citydb.modules.citygml.common.database.cache.**HeapCacheTable**

```
158   model.createIndexes(conn, tableName/*, "nologging"*/);
```

## 3.5 Data types in cached tables

In the folder common.database.cache.model several classes had to be changed due to different data types of the DMBS. NUMBER to NUMERIC (ID-columns = integer), VARCHAR2 to VARCHAR.

# 4. Implicit sequences

Packages:

- ☐ api
- ☐ cmd
- ☐ config
- ☐ database
- ☐ event
- ☐ gui
- ☐ log
- 🟨 modules
- ☐ plugin
- ☐ util

Classes:

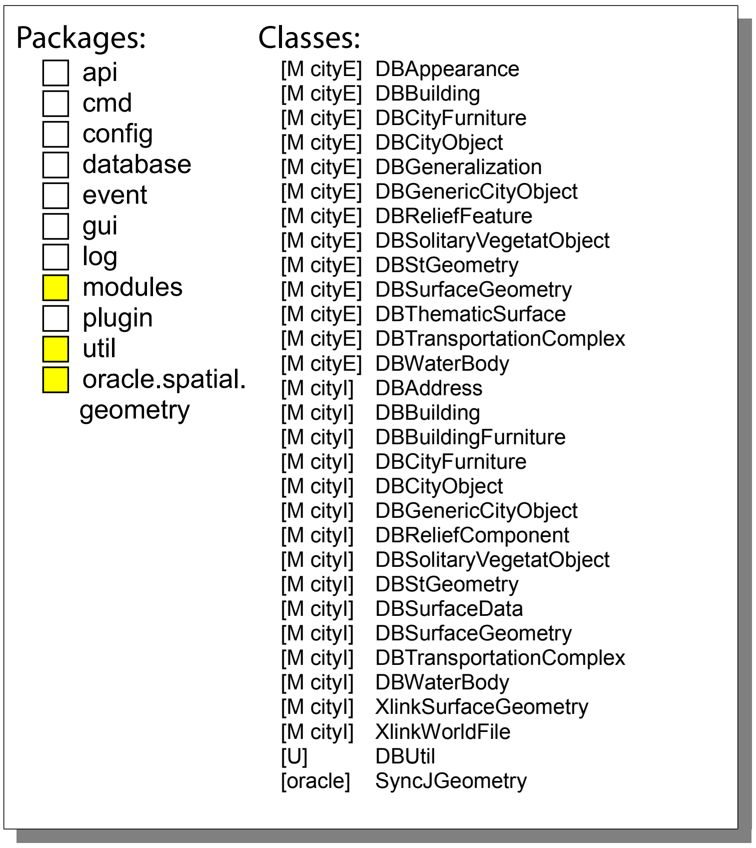
| | |
|---|---|
| [M cityl] | DBAddress |
| [M cityl] | DBAppearance |
| [M cityl] | DBBuilding |
| [M cityl] | DBBuildingFurniture |
| [M cityl] | DBBuildingInstallation |
| [M cityl] | DBCityFurniture |
| [M cityl] | DBCityObjectGroup |
| [M cityl] | DBGenericCityObject |
| [M cityl] | DBImplicitGeometry |
| [M cityl] | DBImporterManager |
| [M cityl] | DBLandUse |
| [M cityl] | DBOpening |
| [M cityl] | DBPlantCover |
| [M cityl] | DBReliefComponent |
| [M cityl] | DBReliefFeature |
| [M cityl] | DBRoom |
| [M cityl] | DBSequencerEnum |
| [M cityl] | DBSolitaryVegetatObject |
| [M cityl] | DBSurfaceData |
| [M cityl] | DBSurfaceGeometry |
| [M cityl] | DBThematicSurface |
| [M cityl] | DBTrafficArea |
| [M cityl] | DBTransportationComplex |
| [M cityl] | DBWaterBody |
| [M cityl] | DBWaterBoundarySurface |
| [M cityl] | XlinkDeprecatedMaterial |
| [M cityl] | XlinkSurfaceGeometry |

In *PostgreSQL* it is quite common to assign the data type SERIAL to ID-columns which are used as primary keys. SERIAL implicitly creates a sequence with the names of the table, the column and the ending "_SEQ". The declaration "CREATE SEQUENCE" must not be written manually like in *Oracle*. But this holds a trap. As names are created automatically with SERIAL they differ from the customized names in *Oracle*. See also ***3.3*** for examples.

de.tub.citydb.modules.citygml.importer.database.content.**DBSequencerEnum**

```
//public enum DBSequencerEnum {
//    ADDRESS_SEQ,
//    APPEARANCE_SEQ,
//    CITYOBJECT_SEQ,
//    SURFACE_GEOMETRY_SEQ,
//    IMPLICIT_GEOMETRY_SEQ,
//    SURFACE_DATA_SEQ,
public enum DBSequencerEnum {
      ADDRESS_ID_SEQ,
      APPEARANCE_ID_SEQ,
      CITYOBJECT_ID_SEQ,
      SURFACE_GEOMETRY_ID_SEQ,
      IMPLICIT_GEOMETRY_ID_SEQ,
      SURFACE_DATA_ID_SEQ,
```

# 5. How to work with database geometries in Java


Packages:

- ☐ api
- ☐ cmd
- ☐ config
- ☐ database
- ☐ event
- ☐ gui
- ☐ log
- 🟨 modules
- ☐ plugin
- 🟨 util
- 🟨 oracle.spatial. geometry

Classes:

| | |
|---|---|
| [M cityE] | DBAppearance |
| [M cityE] | DBBuilding |
| [M cityE] | DBCityFurniture |
| [M cityE] | DBCityObject |
| [M cityE] | DBGeneralization |
| [M cityE] | DBGenericCityObject |
| [M cityE] | DBReliefFeature |
| [M cityE] | DBSolitaryVegetatObject |
| [M cityE] | DBStGeometry |
| [M cityE] | DBSurfaceGeometry |
| [M cityE] | DBThematicSurface |
| [M cityE] | DBTransportationComplex |
| [M cityE] | DBWaterBody |
| [M cityI] | DBAddress |
| [M cityI] | DBBuilding |
| [M cityI] | DBBuildingFurniture |
| [M cityI] | DBCityFurniture |
| [M cityI] | DBCityObject |
| [M cityI] | DBGenericCityObject |
| [M cityI] | DBReliefComponent |
| [M cityI] | DBSolitaryVegetatObject |
| [M cityI] | DBStGeometry |
| [M cityI] | DBSurfaceData |
| [M cityI] | DBSurfaceGeometry |
| [M cityI] | DBTransportationComplex |
| [M cityI] | DBWaterBody |
| [M cityI] | XlinkSurfaceGeometry |
| [M cityI] | XlinkWorldFile |
| [U] | DBUtil |
| [oracle] | SyncJGeometry |

Translating the processing of geometries to the *PostGIS* JDBC-driver was with no doubt the toughest job to do. This chapter shortly explains how geometries were parsed from a CityGML document and inserted into the database and all the way back.

## 5.1 From CityGML to 3DCityDB

The *Oracle* JDBC-driver handles geometries with one central class called `JGeometry`. One instance of `JGeometry` represents SDO_GEOMETRY in the Java-world. All methods of different geometric types return `JGeometry`. They need an array of coordinates, the number of dimensions and a known SRID for doing so. The geometries of CityGML are described by geometric primitives from the `citygml4j.lib`. Their values are first transferred to list-elements and then iterated into arrays to be used by the described `JGeometry`-methods. `JGeometry` can not be set as an object for the database-statements. It needs to be "stored" into a `STRUCT`-object, which is a wrapper-class for `JGeometry`. This wrapper makes the object more generic to be used by the `PreparedStatement`-method `setObject`.

For the *PostGIS* JDBC-driver the combination of geometry-class and wrapper-class is represented by `Geometry` and `PGgeometry`. `Geometry` offers some geometric operations, but to create an instance of `Geometry` the `PGgeometry`-method `geomFromString(String)` has to be used. So the values of list-elements have to iteratively build up a string and not fill an array. The String represents the geometries in Well Known Text (WKT), which means blank spaces between coordinates (x y z) instead of commas. To be interpreted by the database the geometries have to be wrapped as a `PGgeometry` object and then set for the `PreparedStatement`.

de.tub.citydb.modules.citygml.importer.database.content.**DBAddress**

```
91      // private DBSdoGeometry sdoGeometry;
rep+    private DBStGeometry stGeometry;

106     // sdoGeometry = (DBSdoGeometry)dbImporterManager.getDBImporter(
rep+            DBImporterEnum.SDO_GEOMETRY);
        stGeometry = (DBStGeometry)dbImporterManager.getDBImporter(
                DBImporterEnum.ST_GEOMETRY);

133     // JGeometry multiPoint = null;
rep+    PGgeometry multiPoint = null;

224     // multiPoint = sdoGeometry.getMultiPoint(address.getMultiPoint());
rep+    multiPoint = stGeometry.getMultiPoint(address.getMultiPoint());

        // if (multiPoint != null) {
        //      Struct multiPointObj= SyncJGeometry.syncStore(multiPoint,batchConn);
        //      psAddress.setObject(8, multiPointObj);
        // } else
        //      psAddress.setNull(8, Types.STRUCT, "MDSYS.SDO_GEOMETRY");
        if (multiPoint != null) {
                psAddress.setObject(8, multiPoint);
        } else
                psAddress.setNull(8, Types.OTHER, "ST_GEOMETRY");
```

de.tub.citydb.modules.citygml.importer.database.content.**DBCityObject**

```
211     // double[] ordinates = new double[points.size()];
rep+    // int i = 0;
        // for (Double point : points)
        //      ordinates[i++] = point.doubleValue();
        // JGeometry boundedBy =
        //      JGeometry.createLinearPolygon(ordinates, 3, dbSrid);
        // STRUCT obj = SyncJGeometry.syncStore(boundedBy, batchConn);
        //
        // psCityObject.setObject(4, obj);
        String geomEWKT = "SRID=" + dbSrid + ";POLYGON((";
        for (int i=0; i<points.size(); i+=3){
                geomEWKT += points.get(i) + " " + points.get(i+1) + " " +
                        points.get(i+2) + ",";
        }
        geomEWKT = geomEWKT.substring(0, geomEWKT.length() - 1);
        geomEWKT += "))";
        Geometry boundedBy = PGgeometry.geomFromString(geomEWKT);
        PGgeometry pgBoundedBy = new PGgeometry(boundedBy);

        psCityObject.setObject(4, pgBoundedBy);
```

de.tub.citydb.modules.citygml.importer.database.content.**DBCityObject**

```
68      // SDO_GEOMETRY();
        ST_GEOMETRY();
```

de.tub.citydb.modules.citygml.importer.database.content.**DBStGeometry**

```
88      // public JGeometry getPoint(PointProperty pointProperty) {
rep     //    JGeometry pointGeom = null;
        public PGgeometry getPoint(PointProperty pointProperty) throws
        SQLException {
              Geometry pointGeom = null;

99      // double[] coords = new double[values.size()];
        // int i = 0;
        // for (Double value : values)
        //    coords[i++] = value.doubleValue();
        // pointGeom = JGeometry.createPoint(coords, 3, dbSrid);
        pointGeom = PGgeometry.geomFromString("SRID=" + dbSrid + ";POINT(" +
              values.get(0) + " " + values.get(1) + " " + values.get(2) + ")");

171     // if (!pointList.isEmpty()) {
rep     //    Object[] pointArray = new Object[pointList.size()];
        //    int i = 0;
        //    for (List<Double> coordsList : pointList) {
        //          if (affineTransformation)
        //                dbImporterManager.getAffineTransformer().
        //                      transformCoordinates(coordsList);
        //
        //          double[] coords = new double[3];
        //
        //          coords[0] = coordsList.get(0).doubleValue();
        //          coords[1] = coordsList.get(1).doubleValue();
        //          coords[2] = coordsList.get(2).doubleValue();
        //
        //          pointArray[i++] = coords;
        //    }
        //    multiPointGeom = JGeometry.createMultiPoint(pointArray, 3, dbSrid);
        // }
        // }
        // return multiPointGeom;
        if (!pointList.isEmpty()) {
              String geomEWKT = "SRID=" + dbSrid + ";MULTIPOINT(";

              for (List<Double> coordsList : pointList){

                    if (affineTransformation)
                          dbImporterManager.getAffineTransformer().
                                transformCoordinates(coordsList);
                    geomEWKT += coordsList.get(0) + " " + coordsList.get(1) + " "
                            + coordsList.get(2) + ",";
            }

            geomEWKT = geomEWKT.substring(0, geomEWKT.length() - 1);
            geomEWKT += ")";

            multiPointGeom = PGgeometry.geomFromString(geomEWKT);
    }

    }
    PGgeometry pgMultiPointGeom = new PGgeometry(multiPointGeom);
    return pgMultiPointGeom;
```

```
213     // if (!pointList.isEmpty()) {
rep     //     Object[] pointArray = new Object[pointList.size()];
        //     int i = 0;
        //     for (List<Double> coordsList : pointList) {
        //         if (affineTransformation)
        //             dbImporterManager.getAffineTransformer().
        //                 transformCoordinates(coordsList);
        //         double[] coords = new double[coordsList.size()];
        //         int j = 0;
        //         for (Double coord : coordsList)
        //             coords[j++] = coord.doubleValue();
        //
        //         pointArray[i++] = coords;
        //     }
        //     multiCurveGeom = JGeometry.createLinearMultiLineString(pointArray,
        //     3, dbSrid);
        // }
        if (!pointList.isEmpty()) {
            String geomEWKT = "SRID=" + dbSrid + ";MULTILINESTRING((";

            for (List<Double> coordsList : pointList) {
                if (affineTransformation)
                    dbImporterManager.getAffineTransformer().
                        transformCoordinates(coordsList);

                for (int i=0; i<coordsList.size(); i+=3){
                    geomEWKT += coordsList.get(i) + " " +
                    coordsList.get(i+1) + " " + coordsList.get(i+2) + ",";
                }
                geomEWKT = geomEWKT.substring(0, geomEWKT.length() - 1);
                geomEWKT += "),(";
            }
        geomEWKT = geomEWKT.substring(0, geomEWKT.length() - 2);
        geomEWKT += ")";
        multiCurveGeom = PGgeometry.geomFromString(geomEWKT);
        }
```

de.tub.citydb.modules.citygml.importer.database.content.**DBSurfaceData**

```
437     // JGeometry geom = new JGeometry(coords.get(0), coords.get(1), dbSrid);
        // STRUCT obj = SyncJGeometry.syncStore(geom, batchConn);
        // psSurfaceData.setObject(15, obj);
```

```
Geometry geom = PGgeometry.geomFromString("SRID=" + dbSrid + ";POINT(" +
      coords.get(0) + " " + coords.get(1) + ")");
PGgeometry pgGeom = new PGgeometry(geom);
psSurfaceData.setObject(15, pgGeom);
```

de.tub.citydb.modules.citygml.importer.database.xlink.resolver.**XlinkSurfaceGeometry**

283
```
// if (reverse) {
//    int[] elemInfoArray = geomNode.geometry.getElemInfo();
//    double[] ordinatesArray = geomNode.geometry.getOrdinatesArray();
//
//    if (elemInfoArray.length < 3 || ordinatesArray.length == 0) {

//          geomNode.geometry = null;
//          return;
//    }
//
//    // we are pragmatic here. if elemInfoArray contains more than one
//    // entry, we suppose we have one outer ring and anything else are
//    // inner rings.
//    List<Integer> ringLimits = new ArrayList<Integer>();
//    for (int i = 3; i < elemInfoArray.length; i += 3)
//          ringLimits.add(elemInfoArray[i] - 1);
//
//    ringLimits.add(ordinatesArray.length);
//
//    // ok, reverse polygon according to this info
//    Object[] pointArray = new     Object[ringLimits.size()];
//    int ringElem = 0;
//    int arrayIndex = 0;
//    for (Integer ringLimit : ringLimits) {
//          double[] coords = new double[ringLimit - ringElem];
//
//          for (int i=0, j=ringLimit-3; j>=ringElem; j-=3, i+=3) {
//                coords[i] = ordinatesArray[j];
//                coords[i + 1] = ordinatesArray[j + 1];
//                coords[i + 2] = ordinatesArray[j + 2];
//          }
//
//          pointArray[arrayIndex++] = coords;
//          ringElem = ringLimit;
//    }
//
//    JGeometry geom = JGeometry.createLinearPolygon(PointArray,
//          geomNode.geometry.getDimensions(),
//                geomNode.geometry.getSrid());
//
//    geomNode.geometry = geom;
// }
if (reverse) {
      String geomEWKT = "SRID=" + geomNode.geometry.getSrid() +
            ";POLYGON((";
      ComposedGeom polyGeom = (ComposedGeom)geomNode.geometry;
      int dimensions = geomNode.geometry.getDimension();

      for (int i = 0; i < polyGeom.numGeoms(); i++){
            if (dimensions == 2)
                for (int j=0; j<polyGeom.getSubGeometry(i).numPoints(); j++){
                    geomEWKT += polyGeom.getSubGeometry(i).getPoint(j).x + "
                    " + polyGeom.getSubGeometry(i).getPoint(j).y + ",";
                }

            if (dimensions == 3)
                for (int j=0; j<polyGeom.getSubGeometry(i).numPoints(); j++){
                    geomEWKT += polyGeom.getSubGeometry(i).getPoint(j).x + "
                    " + polyGeom.getSubGeometry(i).getPoint(j).y + " " +
                    polyGeom.getSubGeometry(i).getPoint(j).z + ",";
                }

                geomEWKT = geomEWKT.substring(0, geomEWKT.length() - 1);
                geomEWKT += "),(";
            }


            geomEWKT = geomEWKT.substring(0, geomEWKT.length() - 2);
            geomEWKT += ")";

            Geometry geom = PGgeometry.geomFromString(geomEWKT);
            geomNode.geometry = geom;
        }

382     // protected JGeometry geometry;
rep+    protected Geometry geometry;
```

de.tub.citydb.modules.citygml.importer.database.xlink.resolver.**XlinkWorldFile**

```
134     // JGeometry geom = new JGeometry(content.get(4), content.get(5), dbSrid);
        // STRUCT obj = JGeometry.store(geom, batchConn);
        Point ptGeom = new Point(content.get(4), content.get(5));
        Geometry geom = PGgeometry.geomFromString(
            "SRID=" + dbSrid + ";" + ptGeom);
        PGgeometry pgGeom = new PGgeometry(geom);
```

## 5.2 From 3DCityDB back to CityGML

Simply said, the export works the other way around. In *Oracle* the `ResultSet` is casted into the `STRUCT` data type and then "loaded" into a `JGeometry`-Object. The *PostGIS* way works in a similar manner with `PGgeometry.getGeometry`. In *Oracle* `JGeometry` can easily be transferred to arrays and processed back again into list-elements for the CityGML-primitives. The ELEM_INFO_ARRAY helps to distinguish between geometric types. The *PostGIS*-JDBC offers different sub-classes of `Geometry.java`. `ComposedGeom` and `MultiLineString` were used for addressing subgeometries. Fortunately this did not lead to conflicts against the names of the `citygml4j.lib`.

## de.tub.citydb.modules.citygml.exporter.database.content.**DBAppearance**

```
822     // STRUCT struct = (STRUCT)rs.getObject("GT_REFERENCE_POINT");
rep+    // if (!rs.wasNull() && struct != null) {
        //    JGeometry jGeom = JGeometry.load(struct);
        //    double[] point = jGeom.getPoint();
        //
        //    if (point != null && point.length >= 2) {
        //          Point referencePoint = new PointImpl();
        //          List<Double> value = new ArrayList<Double>();
        //                value.add(point[0]);
        //                value.add(point[1]);
        PGgeometry pgGeom = (PGgeometry)rs.getObject("GT_REFERENCE_POINT");
        if (!rs.wasNull() && pgGeom != null) {
              Geometry geom = pgGeom.getGeometry();
              Point referencePoint = new PointImpl();
                    List<Double> value = new ArrayList<Double>();
                          value.add(geom.getPoint(0).getX());
                          value.add(geom.getPoint(0).getY());
```

## de.tub.citydb.modules.citygml.exporter.database.content.**DBCityObject**

```
164     // double[] points = geom.getMBR();
```

```
170     // if (geom.getDimension() == 2) {
        //    lower = new Point(points[0], points[1], 0);
        //    upper = new Point(points[2], points[3], 0);
        // } else {
        //    lower = new Point(points[0], points[1], points[2]);
        //    upper = new Point(points[3], points[4], points[5]);
        if (geom.getDimension() == 2) {
              lower = new Point(geom.getFirstPoint().x, geom.getFirstPoint().y,0);
              upper = new Point(geom.getPoint(2).x, geom.getPoint(2).y, 0);
        } else {
              lower = new Point(geom.getFirstPoint().x, geom.getFirstPoint().y,
                    geom.getFirstPoint().z);
              upper = new Point(geom.getPoint(2).x, geom.getPoint(2).y,
                    geom.getPoint(2).z);
```

## de.tub.citydb.modules.citygml.exporter.database.content.**DBGeneralization**

```
121     // double[] points = geom.getOrdinatesArray();
        // Point lower = new Point(points[0], points[1], points[2]);
        // Point upper = new Point(points[3], points[4], points[5]);
        Point lower = new Point(geom.getFirstPoint().x, geom.getFirstPoint().y,
              geom.getFirstPoint().z);
        Point upper = new Point(geom.getPoint(2).x, geom.getPoint(2).y,
              geom.getPoint(2).z);
```

de.tub.citydb.modules.citygml.exporter.database.content.**DBStGeometry**

```
94    // public PointProperty getPoint(JGeometry geom, boolean setSrsName) {
      //     PointProperty pointProperty = null;
      //     if (geom != null && geom.getType() == JGeometry.GTYPE_POINT) {
      //           pointProperty = new PointPropertyImpl();
      //           int dimensions = geom.getDimensions();
      //
      //           double[] pointCoord = geom.getPoint();
      //
      //           if (pointCoord != null && pointCoord.length >= dimensions) {
      //                 Point point = new PointImpl();
      //
      //                 List<Double> value = new ArrayList<Double>();
      //                 for (int i = 0; i < dimensions; i++)
      //                       value.add(pointCoord[i]);
      public PointProperty getPoint(Geometry geom, boolean setSrsName) {
            PointProperty pointProperty = null;

            if (geom != null && geom.getType() == 1) {
                  pointProperty = new PointPropertyImpl();
                  int dimensions = geom.getDimension();

                  if (dimensions == 2) {
                        Point point = new PointImpl();

                        List<Double> value = new ArrayList<Double>();
                        value.add(geom.getPoint(0).getX());
                        value.add(geom.getPoint(0).getY());
                        .
                        .
                  if (dimensions == 3) {

                        Point point = new PointImpl();
                        List<Double> value = new ArrayList<Double>();
                        value.add(geom.getPoint(0).getX());
                        value.add(geom.getPoint(0).getY());
                        value.add(geom.getPoint(0).getZ());

140   // public PolygonProperty getPolygon(JGeometry geom, boolean setSrsName) {
      //     PolygonProperty polygonProperty = null;
      //
      //     if (geom != null && geom.getType() == JGeometry.GTYPE_POLYGON) {
      //           polygonProperty = new PolygonPropertyImpl();
      //           Polygon polygon = new PolygonImpl();
      //           int dimensions = geom.getDimensions();
      //
      //           int[] elemInfoArray = geom.getElemInfo();
      //           double[] ordinatesArray = geom.getOrdinatesArray();
      //
      //           if (elemInfoArray.length < 3 || ordinatesArray.length == 0)
      //                 return null;
      //
      //           List<Integer> ringLimits = new ArrayList<Integer>();
      //           for (int i = 3; i < elemInfoArray.length; i += 3)
      //                 ringLimits.add(elemInfoArray[i] - 1);
      //
```

```
//          ringLimits.add(ordinatesArray.length);
//
//          boolean isExterior = elemInfoArray[1] == 1003;
//          int ringElem = 0;
//          for (Integer curveLimit : ringLimits) {
//                List<Double> values = new ArrayList<Double>();
//
//                for ( ; ringElem < curveLimit; ringElem++)
//                      values.add(ordinatesArray[ringElem]);
//
//                if (isExterior) {
public PolygonProperty getPolygon(Geometry geom, boolean setSrsName) {
      PolygonProperty polygonProperty = null;

      if (geom != null && geom.getType() == 3) {
            polygonProperty = new PolygonPropertyImpl();
            Polygon polygon = new PolygonImpl();
            int dimensions = geom.getDimension();

            if (geom.getValue() == null)
                  return null;

            ComposedGeom polyGeom = (ComposedGeom)geom;

            for (int i = 0; i < polyGeom.numGeoms(); i++){
                  List<Double> values = new ArrayList<Double>();

            if (dimensions == 2)
            for (int j=0; j<polyGeom.getSubGeometry(i).numPoints(); j++){
                  values.add(polyGeom.getSubGeometry(i).getPoint(j).x);
                  values.add(polyGeom.getSubGeometry(i).getPoint(j).y);
            }

            if (dimensions == 3)
            for (int j=0; j<polyGeom.getSubGeometry(i).numPoints(); j++){
                  values.add(polyGeom.getSubGeometry(i).getPoint(j).x);

                  values.add(polyGeom.getSubGeometry(i).getPoint(j).y);
                  values.add(polyGeom.getSubGeometry(i).getPoint(j).z);
            }
            //isExterior
            if (i == 0) {
```

```
208 // public MultiPointProperty getMultiPointProperty(JGeometry geom, boolean
rep // setSrsName) {
    //    MultiPointProperty multiPointProperty = null;
    //
    //    if (geom != null) {
    //          multiPointProperty = new MultiPointPropertyImpl();
    //          MultiPoint multiPoint = new MultiPointImpl();
    //          int dimensions = geom.getDimensions();
    //
    //    if (geom.getType() == JGeometry.GTYPE_MULTIPOINT) {
    //          double[] ordinates = geom.getOrdinatesArray();
    //
    //          for (int i = 0; i < ordinates.length; i += dimensions) {
    //                Point point = new PointImpl();
```

```
//
//          List<Double> value = new ArrayList<Double>();
//
//          for (int j = 0; j < dimensions; j++)
//                value.add(ordinates[i + j]);
//                .
//                .
//          }
//    } else if (geom.getType() == JGeometry.GTYPE_POINT) {
//          ..
public MultiPointProperty getMultiPointProperty(Geometry geom, boolean
setSrsName) {
      MultiPointProperty multiPointProperty = null;

      if (geom != null) {
            multiPointProperty = new MultiPointPropertyImpl();
            MultiPoint multiPoint = new MultiPointImpl();
            int dimensions = geom.getDimension();

      if (geom.getType() == 4) {
            List<Double> value = new ArrayList<Double>();
            Point point = new PointImpl();

            if (dimensions == 2)
                  for (int i = 0; i < geom.numPoints(); i++) {
                        value.add(geom.getPoint(i).x);
                        value.add(geom.getPoint(i).y);
                  }
            if (dimensions == 3)
                  for (int i = 0; i < geom.numPoints(); i++) {
                        value.add(geom.getPoint(i).x);
                        value.add(geom.getPoint(i).y);
                        value.add(geom.getPoint(i).z);
                  }
            .
            .
            }
      }
      else if (geom.getType() == 1) {
            Point point = new PointImpl();

            List<Double> value = new ArrayList<Double>();
            value.add(geom.getPoint(0).x);
            value.add(geom.getPoint(0).y);

            if (dimensions == 3)
                  value.add(geom.getPoint(0).z);
```

```
355   // public MultiCurveProperty getMultiCurveProperty(JGeometry geom, boolean
rep   // setSrsName) {
      //    MultiCurveProperty multiCurveProperty = null;
      //
      //    if (geom != null) {
      //          multiCurveProperty = new MultiCurvePropertyImpl();
      //          MultiCurve multiCurve = new MultiCurveImpl();
      //          int dimensions = geom.getDimensions();
      //
```

```
//          if (geom.getType() == JGeometry.GTYPE_MULTICURVE ) {
//                int[] elemInfoArray = geom.getElemInfo();
//                double[] ordinatesArray = geom.getOrdinatesArray();
//
//                if (elemInfoArray.length < 3 ||
//                      ordinatesArray.length == 0)
//                            return null;
//
//                List<Integer> curveLimits = new ArrayList<Integer>();
//                      for (int i = 3; i < elemInfoArray.length; i += 3)
//                            curveLimits.add(elemInfoArray[i] - 1);
//
//                curveLimits.add(ordinatesArray.length);
//
//                int curveElem = 0;
//                for (Integer curveLimit : curveLimits) {
//                      List<Double> values = new ArrayList<Double>();
//
//                      for ( ; curveElem < curveLimit; curveElem++)
//                            values.add(ordinatesArray[curveElem]);
//                      .
//                      .
//                      curveElem = curveLimit;
//                }
//          }
//          else if (geom.getType() == JGeometry.GTYPE_CURVE ) {
//                double[] ordinatesArray = geom.getOrdinatesArray();
//                List<Double> value = new ArrayList<Double>();
//
//                for (int i = 0; i < ordinatesArray.length; i++)
//                      value.add(ordinatesArray[i]);
public MultiCurveProperty getMultiCurveProperty(Geometry geom, boolean
setSrsName) {
      MultiCurveProperty multiCurveProperty = null;

      if (geom != null) {
      multiCurveProperty = new MultiCurvePropertyImpl();
      MultiCurve multiCurve = new MultiCurveImpl();
      int dimensions = geom.getDimension();

      if (geom.getType() == 5) {
            MultiLineString mlineGeom = (MultiLineString)geom;

            for (int i = 0; i < mlineGeom.numLines(); i++){

                  List<Double> values = new ArrayList<Double>();

                  if (dimensions == 2)
                        for (int j=0; j<mlineGeom.getLine(i).numPoints();
                        j++){
                          values.add(mlineGeom.getLine(i).getPoint(j).x);
                          values.add(mlineGeom.getLine(i).getPoint(j).y);
                        }
                  if (dimensions == 3)
                        for (int j=0; j<mlineGeom.getLine(i).numPoints();
                        j++){
                          values.add(mlineGeom.getLine(i).getPoint(j).x);
```

```
                    values.add(mlineGeom.getLine(i).getPoint(j).y);
                    values.add(mlineGeom.getLine(i).getPoint(j).z);
                }
                .
                .
            }
        }
        else if (geom.getType() == 2) {
            List<Double> value = new ArrayList<Double>();

            if (dimensions == 2)
                for (int i = 0; i < geom.numPoints(); i++){
                    value.add(geom.getPoint(i).x);
                    value.add(geom.getPoint(i).y);
                }
            if (dimensions == 3)
                for (int i = 0; i < geom.numPoints(); i++){
                    value.add(geom.getPoint(i).x);
                    value.add(geom.getPoint(i).y);
                    value.add(geom.getPoint(i).z);
                }
```

de.tub.citydb.util.database.**DBUtil**

```
308     // STRUCT struct = (STRUCT)rs.getObject(1);
rep+    // if (!rs.wasNull() && struct != null) {
        //    JGeometry jGeom = JGeometry.load(struct);
        //    int dim = jGeom.getDimensions();
        PGgeometry pgGeom = (PGgeometry)rs.getObject(1);
        if (!rs.wasNull() && pgGeom != null) {
            Geometry geom = pgGeom.getGeometry();
            int dim = geom.getDimension();
```

## 5.3 Synchronization of geometric functions

It is proven that `JGeometry`'s method `store(JGeometry)` is not threadsafe and deadlocks can occur. This problem is avoided by synchronizing the storing of `JGeometries` into `STRUCT`-objects with a Java-`Reentrant-Lock` (inside `SyncJGeometry.java`). Until now no such problem occurred for the *PostGIS* version.

# 6. How to deal with textures

| Packages: | Classes: |
|---|---|
| ☐ api | [M cityE] DBAppearance |
| ☐ cmd | [M cityE] DBXlinkExporterTextureImage |
| ☐ config | [M cityI] XlinkTextureImage |
| ☐ database | |
| ☐ event | |
| ☐ gui | |
| ☐ log | |
| 🟨 modules | |
| ☐ plugin | |
| ☐ util | |

As the ORDImage data type differs a lot from the BYTEA data type in *PostgreSQL* it is not surprising that the im- and export of textures had to be changed in many aspects. The advantage of ORDImage over common BLOBs is the possibility to query metadata from the images and also use functions similar to a graphic-processing-software. Some of these features are called in the `DBAppearance` class (see also chapter **3.3**). Overall, the *3DCityDB* hardly uses the abilities of ORDImage. Even Oracle itself recommended the use of BLOBs for the *3DCityDB* to the developers.

## 6.1 Import of textures

As seen on the following examples the code for importing textures could be reduced to a few lines. Inserting ORDImages works as follows:

1. initialization in the database with `ordimage.init()`
2. a "select for update" locks the `ResultSet`-cursor for the row to be updated
3. the database-ORDImage is transferred to a java-ORDImage but still empty
4. `loadDataFromInputStream` fills the empty `ORDImage.java`
5. `setORAData` sets the `ORDImage.java` in the `PreparedStatement` which inserts the data by updating the table Surface_Data

With BLOBs the output of the `InputStream` can directly be set in the `PreparedStatement` with `setBinaryStream`.

de.tub.citydb.modules.citygml.importer.database.xlink.resolver.**XlinkTextureImage**

```
// psPrepare = externalFileConn.prepareStatement(
      "update SURFACE_DATA set TEX_IMAGE=ordimage.init() where ID=?");
// psSelect = externalFileConn.prepareStatement(
      "select TEX_IMAGE from SURFACE_DATA where ID=? for update");
// psInsert = (OraclePreparedStatement)externalFileConn.prepareStatement(
      "update SURFACE_DATA set TEX_IMAGE=? where ID=?");
psInsert = externalFileConn.prepareStatement(
            "update SURFACE_DATA set TEX_IMAGE=? where ID=?");

113+  // // second step: prepare ORDIMAGE
      // psPrepare.setLong(1, xlink.getId());
      // psPrepare.executeUpdate();
      //
      // // third step: get prepared ORDIMAGE to fill it with contents
      // psSelect.setLong(1, xlink.getId());
      // OracleResultSet rs = (OracleResultSet)psSelect.executeQuery();
      //    if (!rs.next()) {
      //          LOG.error("Database error while importing texture file '" +
      //                imageFileName + "'.");
      //
      //          rs.close();

      //          externalFileConn.rollback();
      //          return false;
      //    }

114   // OrdImage imgProxy = (OrdImage)rs.getORAData(
      //    1,OrdImage.getORADataFactory());
      // rs.close();
      FileInputStream fis = new FileInputStream(imageFile);

120   // boolean letDBdetermineProperties = true;
      // if (isRemote) {
      //    InputStream stream = imageURL.openStream();
      //    imgProxy.loadDataFromInputStream(stream);
      // } else {
      //    imgProxy.loadDataFromFile(imageFileName);
      //
      //    // determing image formats by file extension
      //    int index = imageFileName.lastIndexOf('.');
      //    if (index != -1) {
      //          String extension = imageFileName.substring(
      //                index + 1, imageFileName.length());
      //
      //          if (extension.toUpperCase().equals("RGB")) {
      //                imgProxy.setMimeType("image/rgb");
      //                imgProxy.setFormat("RGB");
      //                imgProxy.setContentLength(1);
      //
      //                letDBdetermineProperties = false;
      //          }
      //    }
      // }
      // if (letDBdetermineProperties)
      //    imgProxy.setProperties();
      //
      // psInsert.setORAData(1, imgProxy);
      // psInsert.setLong(2, xlink.getId());
      // psInsert.execute();
      // imgProxy.close();
      if (isRemote) {
            InputStream stream = imageURL.openStream();
            psInsert.setBinaryStream(1, stream);
      } else {
            psInsert.setBinaryStream(1, fis, (int)imageFile.length());
      }
      psInsert.setLong(2, xlink.getId());
      psInsert.execute();
      externalFileConn.commit();
      return true;
```

## 6.2 Export of textures

The export of textures in the *Oracle* version only needs a few lines but is also very ORDImage-specific. Two ways exist for the *PostgreSQL's* BYTEA data type. No performance differences could be noticed until now. The first way was preferred as no array with a fixed size had to be declared. This seemed to be more flexible than the second way.

de.tub.citydb.modules.citygml.exporter.database.xlink.**DBXlinkExporterTextureImage**

```
126 // OracleResultSet rs = (OracleResultSet)psTextureImage.executeQuery();
    ResultSet rs = (ResultSet)psTextureImage.executeQuery();

141 // // read oracle image data type
    // OrdImage imgProxy = (OrdImage)rs.getORAData(
    //     1, OrdImage.getORADataFactory());
    // rs.close();
    //
    // if (imgProxy == null) {
    //     LOG.error("Database error while reading texture file: " + fileName);
    //     return false;
    // }
    //
    // try {
    //     imgProxy.getDataInFile(fileURI);
    // } catch (IOException ioEx) {
    //     LOG.error("Failed to write texture file " + fileName + ": " +
    //           ioEx.getMessage());
    //     return false;
    // } finally {
    //     imgProxy.close();
    // }
```

1st way:

```
    byte[] imgBytes = rs.getBytes(1);
    try {
        FileOutputStream fos = new FileOutputStream(fileURI);
        fos.write(imgBytes);
        fos.close();
    } catch (FileNotFoundException fnfEx) {
        LOG.error("File not found " + fileName + ": " + fnfEx.getMessage());
    } catch (IOException ioEx) {
        LOG.error("Failed to write texture file " + fileName + ": " +
              ioEx.getMessage());
        return false;
    }
```

2nd way:

```
InputStream imageStream = rs.getBinaryStream(1);
if (imageStream == null) {
      LOG.error("Database error while reading texture file: " + fileName);
      return false;
}
try {
      byte[] imgBuffer = new byte[1024];
      FileOutputStream fos = new FileOutputStream(fileURI);
      int l;
      while ((l = imageStream.read(imgBuffer)) > 0) {
          fos.write(imgBuffer, 0, l);
      }
      fos.close();
} catch (FileNotFoundException fnfEx) {
      LOG.error("File not found " + fileName + ": " + fnfEx.getMessage());
} catch (IOException ioEx) {
      LOG.error("Failed to write texture file " + fileName + ": " +
            ioEx.getMessage());
      return false; }
```

# 7. The batchsize of PostgreSQL

Packages:

| | |
|---|---|
| ☐ | api |
| ☐ | cmd |
| 🟨 | config |
| ☐ | database |
| ☐ | event |
| ☐ | gui |
| ☐ | log |
| 🟨 | modules |
| ☐ | plugin |
| ☐ | util |

Classes:

| | |
|---|---|
| [C] | Internal |
| [C] | UpdateBatching |
| [M cityE] | DBExportCache |
| [M cityI] | DBImportXlinkResolverWorker |
| [M cityI] | DBImportXlinkWorker |
| [M cityI] | DBAddress |
| [M cityI] | DBAddressToBuilding |
| [M cityI] | DBAppearance |
| [M cityI] | DBAppearToSurfaceData |
| [M cityI] | DBBuilding |
| [M cityI] | DBBuildingFurniture |
| [M cityI] | DBBuildingInstallation |
| [M cityI] | DBCityFurniture |
| [M cityI] | DBCityObject |
| [M cityI] | DBCityObjectGenericCityObject |
| [M cityI] | DBCityObjectGroup |
| [M cityI] | DBExternalReference |
| [M cityI] | DBGenericCityObject |
| [M cityI] | DBImplicitGeometry |
| [M cityI] | DBLandUse |
| [M cityI] | DBOpening |
| [M cityI] | DBOpeningToThemSurface |
| [M cityI] | DBPlantCover |
| [M cityI] | DBReliefComponent |
| [M cityI] | DBReliefFeatToRelComp |
| [M cityI] | DBReliefFeature |
| [M cityI] | DBRoom |
| [M cityI] | DBSolitaryVegetatObject |
| [M cityI] | DBSurfaceData |
| [M cityI] | DBSurfaceGeometry |
| [M cityI] | DBThematicSurface |
| [M cityI] | DBTrafficArea |
| [M cityI] | DBTransportationComplex |
| [M cityI] | DBWaterBodyToWaterBndSrf |
| [M cityI] | DBWaterBody |
| [M cityI] | DBWaterBoundarySurface |
| [M cityI] | DBImportCache |
| [M cityI] | DBXlinkImporterBasic |
| [M cityI] | DBXlinkImporterDeprecatedMaterial |
| [M cityI] | DBXlinkImporterGroupToCityObject |
| [M cityI] | DBXlinkImporterLibraryObject |
| [M cityI] | DBXlinkImporterLinearRing |
| [M cityI] | DBXlinkImporterSurfacegeometry |
| [M cityI] | DBXlinkImporterTextureAssociation |
| [M cityI] | DBXlinkImporterTextureFile |
| [M cityI] | DBXlinkImporterTextureParam |
| [M cityI] | XlinkBasic |
| [M cityI] | XlinkDeprecatedMaterial |
| [M cityI] | XlinkGroupToCityObject |
| [M cityI] | XlinkSurfaceGeometry |
| [M cityI] | XlinkTexCoordList |
| [M cityI] | XlinkTextureAssociation |
| [M cityI] | XlinkTextureParam |
| [M cityI] | XlinkWorldFile |
| [M cityI] | ResourcesPanel |

The maximum batchsize of *PostgreSQL* was set to 10000. More might be possible, but was not tested. This change in the `Internal` class caused several classes to be changed for compiling. They are all listed in the overview-box.

de.tub.citydb.config.internal.**Internal**

```
//    public static final int ORACLE_MAX_BATCH_SIZE = 65535;
public static final int POSTGRESQL_MAX_BATCH_SIZE = 10000;
```

In the following classes no equivalent methods could be found for the Java `PreparedStatement`. The `psDrain`-batch is now executed and not sent.

de.tub.citydb.modules.citygml.exporter.database.gmlid.**DBExportCache**
de.tub.citydb.modules.citygml.importer.database.gmlid.**DBImportCache**

```
// ((OraclePreparedStatement)psDrains[i]).setExecuteBatch(batchSize);

// ((OraclePreparedStatement)psDrain).sendBatch();
psDrain.executeBatch();
```

# 8. Workspace Management

Packages:

- 🟧 api
- ☐ cmd
- 🟧 config
- 🟧 database
- ☐ event
- ☐ gui
- ☐ log
- 🟧 modules
- ☐ plugin
- 🟧 util

Classes:

| | |
|---|---|
| [A] | DatabaseController |
| [C] | Internal |
| [C] | Database |
| [C] | Workspace |
| [C] | Workspaces |
| [D] | DatabaseConnectionPool |
| [D] | DatabaseControllerImpl |
| [M cityE] | DBExportCache |
| [M cityE] | DBExportXlinkWorker |
| [M cityE] | DBExporter |
| [M cityE] | DBSplitter |
| [M cityE] | ExportPanel |
| [M cityI] | DBImportCache |
| [M cityI] | DBImportXlinkResolverWorker |
| [M cityI] | DBImporter |
| [M cityI] | ImportPanel |
| [M DB] | BoundingBoxOperation |
| [M DB] | DatabaseOperationsPanel |
| [M DB] | ReportOperation |
| [U] | DBUtil |
| [U] | Util |

*PostgreSQL* does not offer a workspace or history management like *Oracle* does. Every part in the Java-code concerning these workspace-features was uncommented but not deleted as there might be a solution for this in the future. The affected packages are colored orange.

# 9. KML-Exporter

Due to the modular architecture of the *Importer/Exporter* no overview-box is needed here as the port of the *KML-Exporter* only affected classes of its module. The code design differs from the CityGML-module. Database queries are collected in one central class and were used as string-constants in other classes. Database geometries were parsed into an array to create the KML primitives. Until now it is only possible to export buildings. In the future a generic class will be used as a parent for sub-classes for other thematic modules of the *3DCityDB*.

## 9.1 Queries

de.tub.citydb.modules.kml.database.**Queries**

```
//    public static final String INSERT_GE_ZOFFSET =
//          "INSERT INTO CITYOBJECT_GENERICATTRIB (ID, ATTRNAME, DATATYPE,
//                STRVAL, CITYOBJECT_ID) " +
//          "VALUES (CITYOBJECT_GENERICATT_SEQ.NEXTVAL, ?, 1, ?,
//                (SELECT ID FROM CITYOBJECT WHERE gmlid = ?))";
//
//    public static final String TRANSFORM_GEOMETRY_TO_WGS84 =
//          "SELECT SDO_CS.TRANSFORM(?, 4326) FROM DUAL";
//
//    public static final String TRANSFORM_GEOMETRY_TO_WGS84_3D =
//          "SELECT SDO_CS.TRANSFORM(?, 4329) FROM DUAL";
//
//    public static final String GET_ENVELOPE_IN_WGS84_FROM_GML_ID =
//          "SELECT SDO_CS.TRANSFORM(co.envelope, 4326) " +
//          "FROM CITYOBJECT co " +
//          "WHERE co.gmlid = ?";
//
//    public static final String GET_ENVELOPE_IN_WGS84_3D_FROM_GML_ID =
//          "SELECT SDO_CS.TRANSFORM(co.envelope, 4329) " +
//          "FROM CITYOBJECT co " +
//          "WHERE co.gmlid = ?";
public static final String INSERT_GE_ZOFFSET =
      "INSERT INTO CITYOBJECT_GENERICATTRIB (ID, ATTRNAME, DATATYPE, " +
                  "STRVAL, CITYOBJECT_ID) " +
      "VALUES (nextval('CITYOBJECT_GENERICATTRIB_ID_SEQ'), ?, 1, ?, " +
            "(SELECT ID FROM CITYOBJECT WHERE gmlid = ?))";

public static final String TRANSFORM_GEOMETRY_TO_WGS84 =
      "SELECT ST_Transform(?, 4326)";

public static final String TRANSFORM_GEOMETRY_TO_WGS84_3D =
      "SELECT ST_Transform(?, 94329)";

public static final String GET_ENVELOPE_IN_WGS84_FROM_GML_ID =
      "SELECT ST_Transform(co.envelope, 4326) " +
      "FROM CITYOBJECT co " +
      "WHERE co.gmlid = ?";

public static final String GET_ENVELOPE_IN_WGS84_3D_FROM_GML_ID =
      "SELECT ST_Transform(co.envelope, 94329) " +
      "FROM CITYOBJECT co " +
      "WHERE co.gmlid = ?";
```

The following example is a bit tricky. In *Oracle* it is possible to do a sort of pyramid-aggregation. That means aggregations are primarily done on smaller groups which are then aggregated to bigger groups and so on (see GROUP BY-clauses at the end of the query). Depending on the size of the `surface_geometry`-table it will work much faster than the *PostGIS* ST_Union-operation.

```
//    public static final String BUILDING_GET_AGGREGATE_GEOMETRIES_FOR_LOD
//    =
//          "SELECT sdo_aggr_union(mdsys.sdoaggrtype(aggr_geom,
                <TOLERANCE>)) aggr_geom " +
//          "FROM (SELECT sdo_aggr_union(mdsys.sdoaggrtype(aggr_geom,
                <TOLERANCE>)) aggr_geom " +
//          "FROM (SELECT sdo_aggr_union(mdsys.sdoaggrtype(aggr_geom,
                <TOLERANCE>)) aggr_geom " +
//          "FROM (SELECT sdo_aggr_union(mdsys.sdoaggrtype(simple_geom,
                <TOLERANCE>)) aggr_geom " +
//          "FROM (" +
//
//          "SELECT * FROM (" +
//          "SELECT * FROM (" +
//
//          "SELECT geodb_util.to_2d(sg.geometry, <2D_SRID>) AS
                simple_geom " +
////        "SELECT geodb_util.to_2d(sg.geometry, (select srid from
                database_srs)) AS simple_geom " +
////        "SELECT sg.geometry AS simple_geom " +
//          "FROM SURFACE_GEOMETRY sg " +
//          "WHERE " +
//            "sg.root_id IN( " +
//               "SELECT b.lod<LoD>_geometry_id " +
//               "FROM CITYOBJECT co, BUILDING b " +
//               "WHERE "+
//                 "co.gmlid = ? " +
//                 "AND b.building_root_id = co.id " +
//                 "AND b.lod<LoD>_geometry_id IS NOT NULL " +
//               "UNION " +
//               "SELECT ts.lod<LoD>_multi_surface_id " +
//               "FROM CITYOBJECT co, BUILDING b, THEMATIC_SURFACE ts " +
//               "WHERE "+
//                 "co.gmlid = ? " +
//                 "AND b.building_root_id = co.id " +
//                 "AND ts.building_id = b.id " +
//                 "AND ts.lod<LoD>_multi_surface_id IS NOT NULL "+
//            ") " +
//            "AND sg.geometry IS NOT NULL" +
//
//          ") WHERE sdo_geom.validate_geometry(simple_geom, <TOLERANCE>)
                = 'TRUE'" +
//          ") WHERE sdo_geom.sdo_area(simple_geom, <TOLERANCE>) >
                <TOLERANCE>" +
//
//          ") " +
//          "GROUP BY mod(rownum, <GROUP_BY_1>) " +
      //          ") " +
      //          "GROUP BY mod (rownum, <GROUP_BY_2>) " +
      //          ") " +
      //          "GROUP BY mod (rownum, <GROUP_BY_3>) " +
      //          ")";

      "SELECT ST_Union(get_valid_area.simple_geom) " +
      "FROM (" +
      "SELECT * FROM (" +
         "SELECT * FROM (" +
            "SELECT ST_Force_2D(sg.geometry) AS simple_geom " +
            "FROM SURFACE_GEOMETRY sg " +
            "WHERE " +
                  "sg.root_id IN( " +
                        "SELECT b.lod<LoD>_geometry_id " +
                        "FROM CITYOBJECT co, BUILDING b " +
                        "WHERE "+
                              "co.gmlid = ? " +
                              "AND b.building_root_id = co.id " +
                              "AND b.lod<LoD>_geometry_id IS NOT NULL " +
                        "UNION " +
                        "SELECT ts.lod<LoD>_multi_surface_id " +
                        "FROM CITYOBJECT co, BUILDING b, THEMATIC_SURFACE ts " +
                        "WHERE "+
                              "co.gmlid = ? " +
                              "AND b.building_root_id = co.id " +
                              "AND ts.building_id = b.id " +
                              "AND ts.lod<LoD>_multi_surface_id IS NOT NULL "+
                        ") " +
                  "AND sg.geometry IS NOT NULL) AS get_geoms " +
         "WHERE ST_IsValid(get_geoms.simple_geom) = 'TRUE') AS get_valid_geoms "
      "WHERE ST_Area(get_valid_geoms.simple_geom) > <TOLERANCE>) AS
      get_valid_area";  // PostgreSQL-Compiler needs subquery-aliases

623   //    public static final String QUERY_EXTRUDED_HEIGHTS =
      //          "SELECT " + // "b.measured_height, " +
      //          "SDO_GEOM.SDO_MAX_MBR_ORDINATE(co.envelope, 3) -
                        SDO_GEOM.SDO_MIN_MBR_ORDINATE(co.envelope, 3) AS
                        envelope_measured_height " +
      //          "FROM CITYOBJECT co " + // ", BUILDING b " +
      //          "WHERE " +
      //                "co.gmlid = ?"; // + " AND b.building_root_id = co.id";
      public static final String GET_EXTRUDED_HEIGHT =
            "SELECT " + // "b.measured_height, " +
            "ST_ZMax(Box3D(co.envelope)) - ST_ZMin(Box3D(co.envelope)) AS
                  envelope_measured_height " +
            "FROM CITYOBJECT co " + // ", BUILDING b " +
            "WHERE co.gmlid = ?"; // + " AND b.building_root_id = co.id";

530   // public static final String GET_GMLIDS =
rep         "SELECT co.gmlid, co.class_id " +
            "FROM CITYOBJECT co " +
            "WHERE " +
              "(SDO_RELATE(co.envelope, MDSYS.SDO_GEOMETRY(2002, ?, null, " +
                  "MDSYS.SDO_ELEM_INFO_ARRAY(1,2,1), " +
                  "MDSYS.SDO_ORDINATE_ARRAY(?,?,?,?,?,?)), " +
                  "'mask=overlapbdydisjoint') ='TRUE') " +
            "UNION ALL " +
            "SELECT co.gmlid, co.class_id " +
            "FROM CITYOBJECT co " +
            "WHERE " +
              "(SDO_RELATE(co.envelope, MDSYS.SDO_GEOMETRY(2003, ?, null,
                  "MDSYS.SDO_ELEM_INFO_ARRAY(1,1003,3), " +
                  "MDSYS.SDO_ORDINATE_ARRAY(?,?,?,?)), " +
                  "'mask=inside+coveredby') ='TRUE') " +
            "UNION ALL " +
            "SELECT co.gmlid, co.class_id " +
            "FROM CITYOBJECT co " +
            "WHERE " +
              "(SDO_RELATE(co.envelope, MDSYS.SDO_GEOMETRY(2003, ?, null, " +
                  "MDSYS.SDO_ELEM_INFO_ARRAY(1,1003,3), " +
                  "MDSYS.SDO_ORDINATE_ARRAY(?,?,?,?)), 'mask=equal') ='TRUE') "
            + "ORDER BY 2"; // ORDER BY co.class_id*/
      public static final String GET_GMLIDS =
            "SELECT co.gmlid, co.class_id " +
            "FROM CITYOBJECT co " +
            "WHERE " +
              // overlap
              "ST_Relate(co.envelope, ST_GeomFromEWKT(?), 'T*T***T**') ='TRUE' "
              + "UNION ALL " +
              "SELECT co.gmlid, co.class_id " +
              "FROM CITYOBJECT co " +
              "WHERE " +
                  "(ST_Relate(co.envelope, ST_GeomFromEWKT(?), 'T*F**F***')
                        ='TRUE' OR " +    // inside and coveredby
                  "ST_Relate(co.envelope, ST_GeomFromEWKT(?), '*TF**F***')
                        ='TRUE' OR " +    // coveredby
                  "ST_Relate(co.envelope, ST_GeomFromEWKT(?), '**FT*F***')
                        ='TRUE' OR " +    // coveredby
                  "ST_Relate(co.envelope, ST_GeomFromEWKT(?), '**F*TF***')
                        ='TRUE') " +      // coveredby
            "UNION ALL " +
              "SELECT co.gmlid, co.class_id " +
              "FROM CITYOBJECT co " +
              "WHERE " +
                  "ST_Relate(co.envelope, ST_GeomFromEWKT(?), 'T*F**FFF*')
                        ='TRUE' " +       // equal
                  "ORDER BY 2"; // ORDER BY co.class_id*/
```

Like for the CityGML-Export the RELATE-operations can only be sent as an `PreparedStatement` to the *PostGIS* database when using a single string as bind variable.

de.tub.citydb.modules.kml.database.**KmlSplitter**

```
264   //    BoundingBox tile =
rep   //          exportFilter.getBoundingBoxFilter().getFilterState();
      //    OracleResultSet rs = null;
      //    PreparedStatement spatialQuery = null;
      //    try {
      //          spatialQuery =
      //          connection.prepareStatement(TileQueries.QUERY_GET_GMLIDS);
      //          int srid =
      //          DatabaseConnectionPool.getInstance().
      //          getActiveConnectionMetaData().getReferenceSystem().getSrid();
      //
      //          spatialQuery.setInt(1, srid);
      //          // coordinates for inside
      //          spatialQuery.setDouble(2, tile.getLowerLeftCorner().getX());
      //          spatialQuery.setDouble(3, tile.getLowerLeftCorner().getY());
      //          spatialQuery.setDouble(4, tile.getUpperRightCorner().getX());
      //          spatialQuery.setDouble(5, tile.getUpperRightCorner().getY());
      //          spatialQuery.setInt(6, srid);
      //
      //          // coordinates for overlapbdydisjoint
      //          spatialQuery.setDouble(7, tile.getLowerLeftCorner().getX());
      //          spatialQuery.setDouble(8, tile.getUpperRightCorner().getY());
      //          spatialQuery.setDouble(9, tile.getLowerLeftCorner().getX());
      //          spatialQuery.setDouble(10, tile.getLowerLeftCorner().getY());
      //          spatialQuery.setDouble(11, tile.getUpperRightCorner().getX());
      //          spatialQuery.setDouble(12, tile.getLowerLeftCorner().getY());
      //
      //          rs = (OracleResultSet)query.executeQuery();
      ResultSet rs = null;
      PreparedStatement query = null;
      String lineGeom = null;
      String polyGeom = null;

      try {
        if (filterConfig.isSetComplexFilter() &&
            filterConfig.getComplexFilter().getTiledBoundingBox().isSet()) {

            query =connection.prepareStatement(
                          Queries.CITYOBJECTGROUP_MEMBERS_IN_BBOX);

            BoundingBox tile = exportFilter.getBoundingBoxFilter()
                                                           .getFilterState();
            int srid = dbSrs.getSrid();

            lineGeom = "SRID=" + srid + ";LINESTRING(" +
                  tile.getLowerLeftCorner().getX() + " " +
                  tile.getUpperRightCorner().getY() + "," +
                  tile.getLowerLeftCorner().getX() + " " +
                  tile.getLowerLeftCorner().getY() + "," +
                  tile.getUpperRightCorner().getX() + " " +
                  tile.getLowerLeftCorner().getY() + ")'";

            polyGeom = "SRID=" + srid + ";POLYGON((" +
                  tile.getLowerLeftCorner().getX() + " " +
                  tile.getLowerLeftCorner().getY() + "," +
                  tile.getLowerLeftCorner().getX() + " " +
                  tile.getUpperRightCorner().getY() + "," +
                  tile.getUpperRightCorner().getX() + " " +
                  tile.getUpperRightCorner().getY() + "," +
                  tile.getUpperRightCorner().getX() + " " +
                  tile.getLowerLeftCorner().getY() + "," +
                  tile.getLowerLeftCorner().getX() + " " +
                  tile.getLowerLeftCorner().getY() + "))";

            query.setString(1, lineGeom);
            query.setString(2, polyGeom);
```

```
        query.setString(3, polyGeom);
        query.setString(4, polyGeom);
        query.setString(5, polyGeom);
        query.setString(6, polyGeom);

        rs = query.executeQuery();
```

The `BallonTemplateHandlerImpl` class builds up a queries for the KML balloon-content. Most of them are aggregated queries. If multiple rows are fetched by the `ResultSet` and no aggregation was used one row has to be picked. Therefore the window function ROW_NUMBER() was used. As *PostgreSQL* does not allow the usage of window function inside of a WHERE clause the queries have to be re-written in a more nested way. Except for the first example, that did not need a range condition for rnum like in *Oracle*.

de.tub.citydb.modules.kml.database.**BalloonTemplateHandlerImpl**

```
1152  sqlStatement = sqlStatement + ") AS subquery"; // PostgreSQL-Query needs
rep                                                       an alias here

1206  //    sqlStatement = "SELECT * FROM " +
      //          " (SELECT a.*, ROWNUM rnum FROM (" + sqlStatement +
      //          " ORDER by " + tableShortId + "." + columns.get(0) + " ASC) a"
      //          + " WHERE ROWNUM <= " + rownum + ") "
      //          + "WHERE rnum >= " + rownum;
      sqlStatement = "SELECT * FROM " +
      "(SELECT sqlstat.*, ROW_NUMBER() OVER(ORDER BY sqlstat.* ASC) AS rnum" +
            " FROM (" + sqlStatement +
            " ORDER BY " + tableShortId + "." + columns.get(0) + " ASC) sqlstat)
            AS subq WHERE rnum = " + rownum;

      //    else if (FIRST.equalsIgnoreCase(aggregateFunction)) {
      //          sqlStatement = "SELECT * FROM (" + sqlStatement +
      //          " ORDER by " + tableShortId + "." + columns.get(0) + " ASC)" +
      //          " WHERE ROWNUM = 1";
      //    }
      //    else if (LAST.equalsIgnoreCase(aggregateFunction)) {
      //          sqlStatement = "SELECT * FROM (" + sqlStatement +
      //          " ORDER by " + tableShortId + "." + columns.get(0) + " DESC)"
      //          + " WHERE ROWNUM = 1";
      //    }
      else if (FIRST.equalsIgnoreCase(aggregateFunction)) {
            sqlStatement = "SELECT * FROM " +
            "(SELECT sqlstat.*, ROW_NUMBER() OVER(ORDER BY sqlstat.* ASC)
            AS rnum FROM (" + sqlStatement +
            " ORDER BY " + tableShortId + "." + columns.get(0) + " ASC) sqlstat)
            AS subq WHERE rnum = 1";
      }
      else if (LAST.equalsIgnoreCase(aggregateFunction)) {
            sqlStatement = "SELECT * FROM " +
            "(SELECT sqlstat.*, ROW_NUMBER() OVER(ORDER BY sqlstat.* ASC)
            AS rnum FROM (" + sqlStatement +
            " ORDER BY " + tableShortId + "." + columns.get(0) + " DESC)
            sqlstat) AS subq WHERE rnum = 1";
      }
```

## 9.2 Geometries for Placemarks

Most of the changes were similar to examples in chapter 5 and more or less self-explaining. The `JGeometry.getOrdinatesArray()`-method is substituted with a simple iteration to fill an array. Some extra variables and *PostGIS* JDBC-classes (and their methods) are used to port *Oracle*'s `ELEM-INFO` accessors correctly.

de.tub.citydb.modules.kml.database.**CityObjectGroup**

```
189   //    STRUCT buildingGeometryObj = (STRUCT)rs.getObject(1);
      PGgeometry pgBuildingGeometry = (PGgeometry)rs.getObject(1);

201   //    JGeometry groundSurface =
rep+        convertToWGS84(JGeometry.load(buildingGeometryObj));
      //    int dim = groundSurface.getDimensions();
      //    for (int i = 0; i < groundSurface.getElemInfo().length; i = i+3) {
      //          LinearRingType linearRing = kmlFactory.createLinearRingType();
      //          BoundaryType boundary = kmlFactory.createBoundaryType();
      //          boundary.setLinearRing(linearRing);
      //          switch (groundSurface.getElemInfo()[i+1]) {
      //                case EXTERIOR_POLYGON_RING:   // = 1003
      //                      polygon.setOuterBoundaryIs(boundary);
      //                            break;
      //                case INTERIOR_POLYGON_RING:   // = 2003
      //                      polygon.getInnerBoundaryIs().add(boundary);
      //                      break;
      //                case POINT:                   // = 1
      //                case LINE_STRING:             // = 2
      //                      continue;
      //                default:
      //                      Logger.getInstance().warn("Unknown
                                    geometry for " + work.getGmlId());
      //                      continue;
      //          }
      //    double[] ordinatesArray = groundSurface.getOrdinatesArray();
      //    int startNextGeometry =((i+3)< groundSurface.getElemInfo().length) ?
      //          groundSurface.getElemInfo()[i+3]- 1: // still more geometries
      //                ordinatesArray.length;          // default
      //
      //    // order points counter-clockwise
      //    for (int j = startNextGeometry - dim;
                  j >= groundSurface.getElemInfo()[i] - 1; j = j dim) {
      //          linearRing.getCoordinates().add(String.valueOf(
                  ordinatesArray[j] + "," + ordinatesArray[j+1] + ",0"));
      //    }
      Geometry groundSurface = convertToWGS84(pgBuildingGeometry.getGeometry());

      switch (groundSurface.getSubGeometry(i).getType()) {
            case POLYGON:
              Polygon polyGeom = (Polygon)groundSurface;

              for (int ring = 0; ring < polyGeom.numRings(); ring++){
                LinearRingType linearRing = kmlFactory.createLinearRingType();
                BoundaryType boundary = kmlFactory.createBoundaryType();
                boundary.setLinearRing(linearRing);

                double [] ordinatesArray =
                  new double[polyGeom.getRing(ring).numPoints()*2];

                for (int j=polyGeom.getRing(ring).numPoints()-1,k=0;
                  j>=0;j--,k+=2){
                  ordinatesArray[k] = polyGeom.getRing(ring).getPoint(j).x;
                  ordinatesArray[k+1] = polyGeom.getRing(ring).getPoint(j).y;
                }

                // the first ring usually is the outer ring in a PostGIS-Polygon
                // e.g. POLYGON((outerBoundary),(innerBoundary),(innerBoundary))
                if (ring == 0){
                  polygon.setOuterBoundaryIs(boundary);
                  for (int j = 0; j < ordinatesArray.length; j+=2) {
                    linearRing.getCoordinates().add
                      (String.valueOf(ordinatesArray[j] + "," +
                         ordinatesArray[j+1] + ",0"));
                  }
                }
                else {
                  polygon.getInnerBoundaryIs().add(boundary);
                  for (int j = ordinatesArray.length - 2; j >= 0; j-=2) {
                    linearRing.getCoordinates().add(
                      String.valueOf(ordinatesArray[j] + "," +
                        ordinatesArray[j+1] + ",0"));
                  }
                }
              }
              break;
            case POINT:
            case LINE_STRING:
                  continue;
            default:
                  Logger.getInstance().warn("Unknown geometry for " +
                        work.getGmlId());
                  continue;
            }
        }
```

de.tub.citydb.modules.kml.database.**KmlGenericObject**

```
153   protected static final int POINT = 1;
      protected static final int LINE_STRING = 2;
      protected static final int POLYGON = 3;
      //    private static final int EXTERIOR_POLYGON_RING = 1003;
      //    private static final int INTERIOR_POLYGON_RING = 2003;

1956  //    STRUCT buildingGeometryObj = (STRUCT)rs.getObject(1);
rep   //    JGeometry surface =
                  convertToWGS84(JGeometry.load(buildingGeometryObj));
      //    double[] ordinatesArray = surface.getOrdinatesArray();
      PGgeometry pgBuildingGeometry = (PGgeometry)rs.getObject(1);
      Polygon surface =
            (Polygon)convertToWGS84(pgBuildingGeometry.getGeometry());
      double[] ordinatesArray = new double[surface.numPoints()*3];

      for (int i = 0, j = 0; i < surface.numPoints(); i++, j+=3){
            ordinatesArray[j] = surface.getPoint(i).x;
            ordinatesArray[j+1] = surface.getPoint(i).y;
            ordinatesArray[j+2] = surface.getPoint(i).z;
      }

1989  //    for (int i = 0; i < surface.getElemInfo().length; i = i+3) {
rep   //          LinearRingType linearRing = kmlFactory.createLinearRingType();
      //          BoundaryType boundary = kmlFactory.createBoundaryType();
      //          boundary.setLinearRing(linearRing);
      //          if (surface.getElemInfo()[i+1] == EXTERIOR_POLYGON_RING) {
      //                polygon.setOuterBoundaryIs(boundary);
      //          }
      //          else { // INTERIOR_POLYGON_RING
      //                polygon.getInnerBoundaryIs().add(boundary);
      //          }
      //
      //          int startNextRing = ((i+3) <  surface.getElemInfo().length) ?
      //                surface.getElemInfo()[i+3] - 1: //  still holes to come
      //                      ordinatesArray.length; // default
      //
      //          // order points clockwise
      //          for (int j = surface.getElemInfo()[i] - 1; j < startNextRing;
                        j = j+3) {
      //                linearRing.getCoordinates().add(
                           String.valueOf(
                              reducePrecisionForXorY(ordinatesArray[j]) + "," +
      //                      reducePrecisionForXorY(ordinatesArray[j+1]) +","+
      //                      reducePrecisionForZ(ordinatesArray[j+2] +
                              zOffset)));
      //
      //                probablyRoof = ...
      int cellCount = 0; // equivalent to first value of Oracle's SDO_ELEM_INFO

      for (int i = 0; i < surface.numRings(); i++){
            LinearRingType linearRing = kmlFactory.createLinearRingType();
            BoundaryType boundary = kmlFactory.createBoundaryType();
            boundary.setLinearRing(linearRing);
            if (i == 0) {     // first ring is the outer ring
                  polygon.setOuterBoundaryIs(boundary);
            } else {
                  polygon.getInnerBoundaryIs().add(boundary);
            }
            int startNextRing = ((i+1) < surface.numRings()) ?
                  (surface.getRing(i).numPoints()*3): // still holes to come
                        ordinatesArray.length; // default

            // order points clockwise
            for (int j = cellCount; j < startNextRing; j+=3 {
              linearRing.getCoordinates().add(
                String.valueOf(
                  reducePrecisionForXorY(ordinatesArray[j]) + "," +
                  reducePrecisionForXorY(ordinatesArray[j+1]) + "," +
                  reducePrecisionForZ(ordinatesArray[j+2] + zOffset)))
```

```
                 probablyRoof = ...
            }
            cellCount += (surface.getRing(i).numPoints()*3);
      }

2453  //    int contourCount = unconvertedSurface.getElemInfo().length/3;
      //    // remove normal-irrelevant points
      //    int startContour1 = unconvertedSurface.getElemInfo()[0] - 1;
      //    int endContour1 = (contourCount == 1) ?
      //      ordinatesArray.length: // last
      //        unconvertedSurface.getElemInfo()[3] - 1; // holes are irrelevant
                                                          for normal calculation
      //    // last point of polygons in gml is identical to first and useless
            // for GeometryInfo
      //    endContour1 = endContour1 - 3;
      int contourCount = unconvertedSurface.numRings();
      int startContour1 = 0;
      int endContour1 = (contourCount == 1) ?
            ordinatesArray.length: // last
                  (unconvertedSurface.getRing(startContour1).numPoints()*3);
      endContour1 = endContour1 - 3;

2483  //    for (int i = 0; i < ordinatesArray.length; i = i + 3) {
      //      // coordinates = coordinates + hlDistance * (dot product of normal
              // vector and unity vector)
      //      ordinatesArray[i] = ordinatesArray[i] + hlDistance * nx;
      //      ordinatesArray[i+1] = ordinatesArray[i+1] + hlDistance * ny;
      //      ordinatesArray[i+2] = ordinatesArray[i+2]+zOffset+hlDistance*nz;
      //    }

      for (int i = 0, j = 0; i < unconvertedSurface.numPoints(); i++, j+=3){
        unconvertedSurface.getPoint(i).x = ordinatesArray[j] + hlDistance*nx;
        unconvertedSurface.getPoint(i).y = ordinatesArray[j+1] + hlDistance*ny;
        unconvertedSurface.getPoint(i).z = ordinatesArray[j+2] + zOffset +
                                                  hlDistance * nz;
      }
```

## 9.3 Textures for COLLADA-Export

The database can store texture formats that are unknown to ORDImage. Therefore two methodologies were implemented in the *KML-Exporter*. One to deal with ORDImages and another to process all the unknown formats as BLOBs. Fortunately the last one could be used for the *PostGIS* port. All the TexOrdImage methods had to be uncommented from the following classes and the texture-export for COLLADA exports was slightly changed.

de.tub.citydb.modules.kml.database.**KmlGenericObject**

```
2161  //    OrdImage texImage = null;
      InputStream texImage = null;

2176  // texImage = (OrdImage)rs2.getORAData("tex_image",
            OrdImage.getORADataFactory());
      texImage = rs2.getBinaryStream("tex_image");
      addTexImageUri(surfaceId, texImageUri);
      // if (getTexOrdImage(texImageUri) == null) { // not already marked as
                                                     wrapping texture

            BufferedImage bufferedImage = null;
            try {
              //bufferedImage = ImageIO.read(texImage.getDataInStream());
              bufferedImage = ImageIO.read(texImage);
            }
            catch (IOException ioe) {}
              if (bufferedImage != null) { // image in JPEG, PNG or another
                                              usual format
                addTexImage(texImageUri, bufferedImage);
              }
      //      else {
      //        addTexOrdImage(texImageUri, texImage);
      //      }
      // }

2256  removeTexImage(texImageUri);
      //    addTexOrdImage(texImageUri, texImage);
      BufferedImage bufferedImage = null;
         try {
            bufferedImage = ImageIO.read(texImage);
         } catch (IOException e) {}
         addTexImage(texImageUri, bufferedImage);
```

de.tub.citydb.modules.kml.concurrent.**KmlExportWorker**
de.tub.citydb.modules.kml.controller.**KmlExporter**
de.tub.citydb.modules.kml.database.**ColladaBundle**
de.tub.citydb.modules.kml.database.**KmlExporterManager**

```
rep+  //    uncommented TexOrdImage-methods
```