Benchmark results pt 1

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Personal intro

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IfcOpenShell

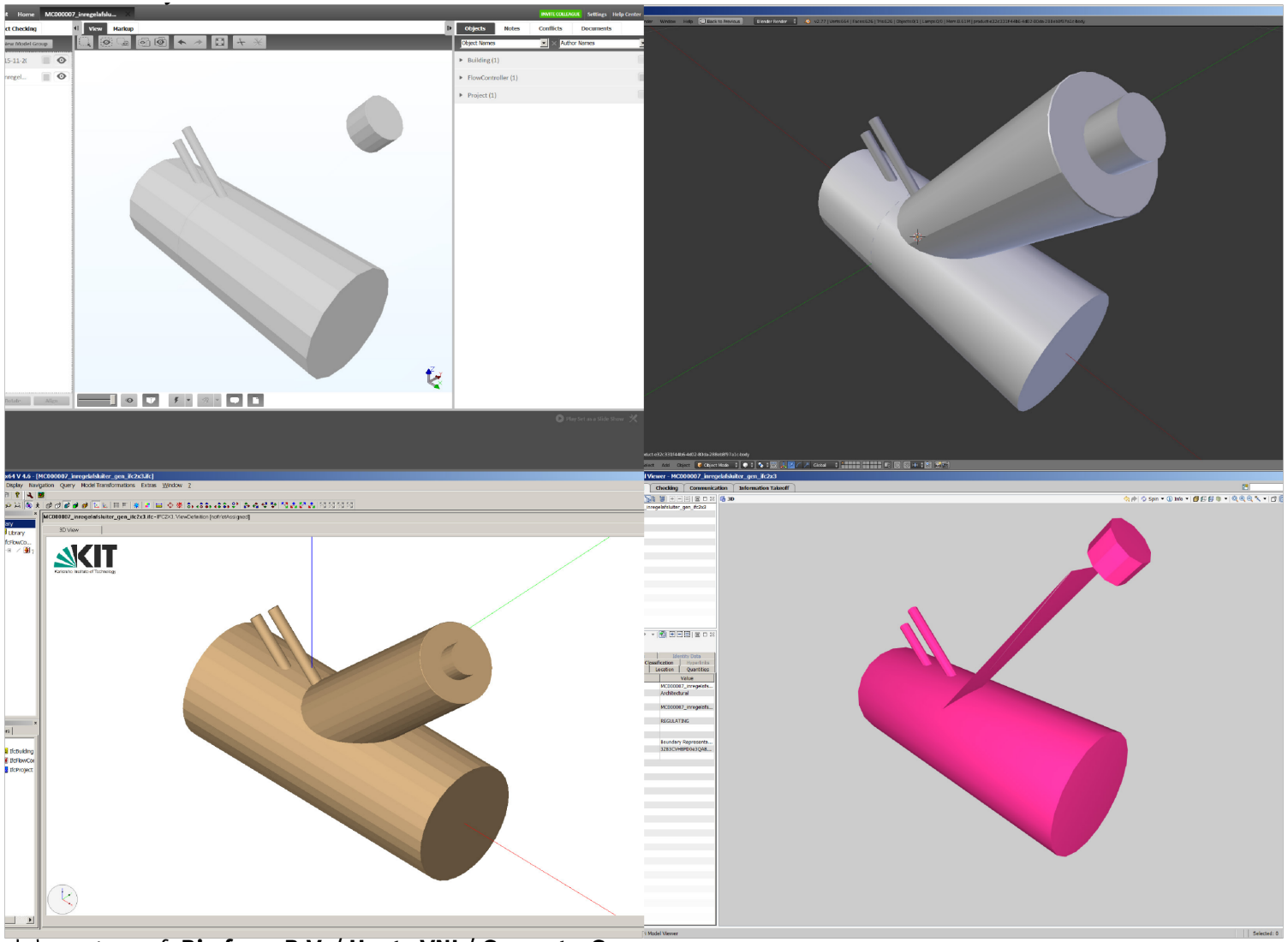
the open source ifc toolkit and geometry engine

AECgeeks

Software development and consultancy for the Architecture Engineering and Construction industry.

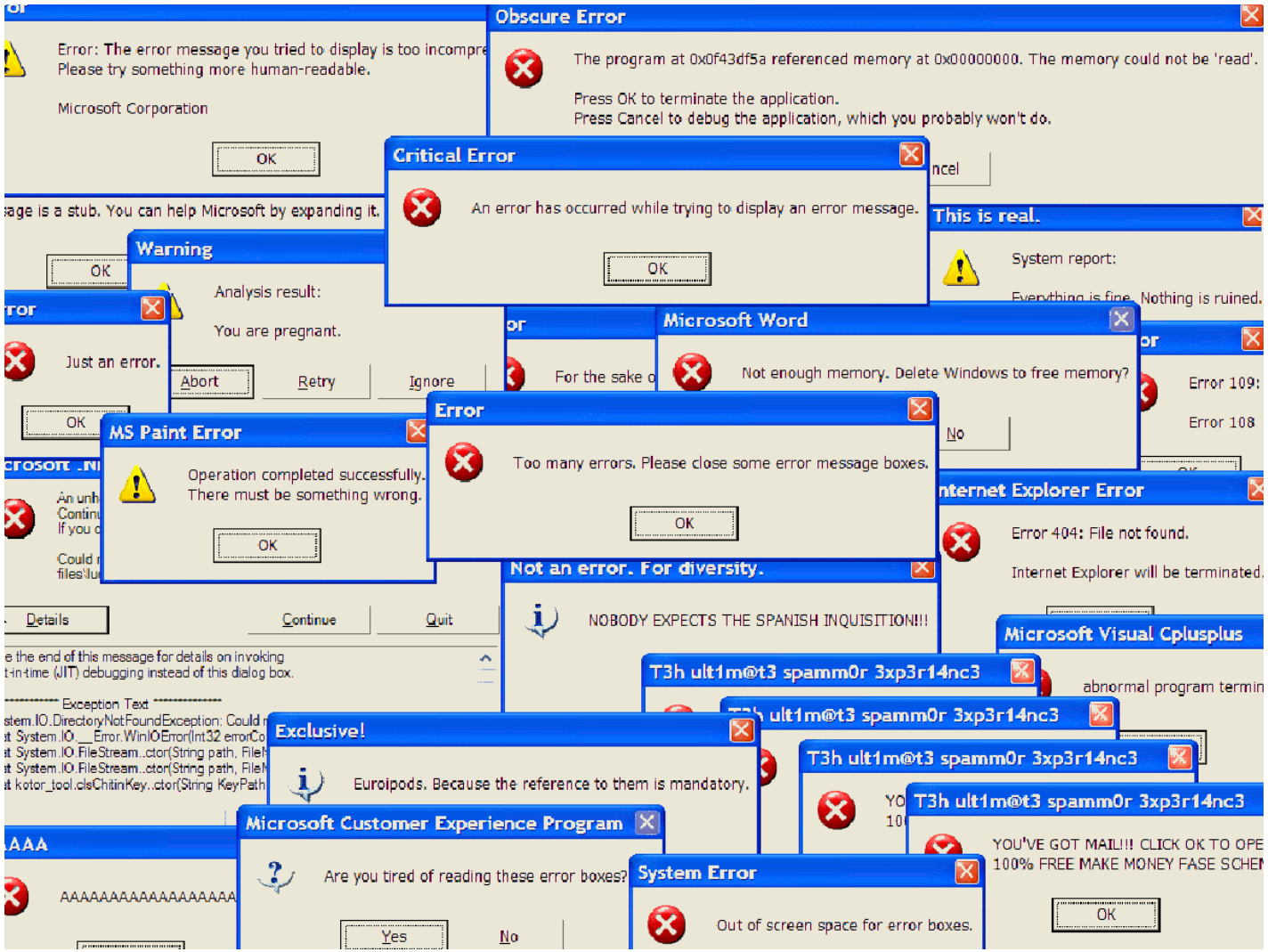
TU Delft

Geometry interoperability

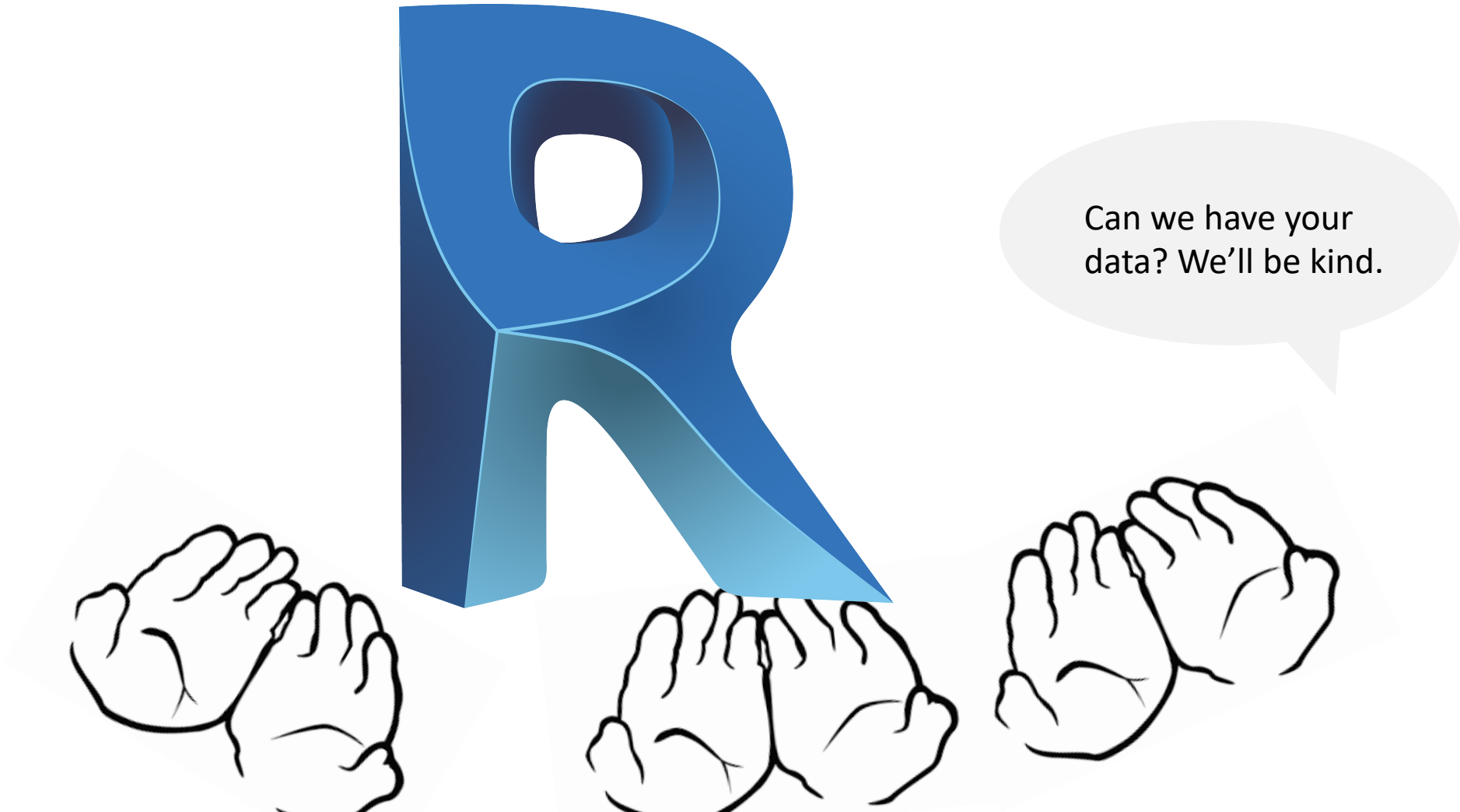


model courtesy of: **Bimforce B.V. / Uneto VNI / GeometryGym**

Approaches to conformance

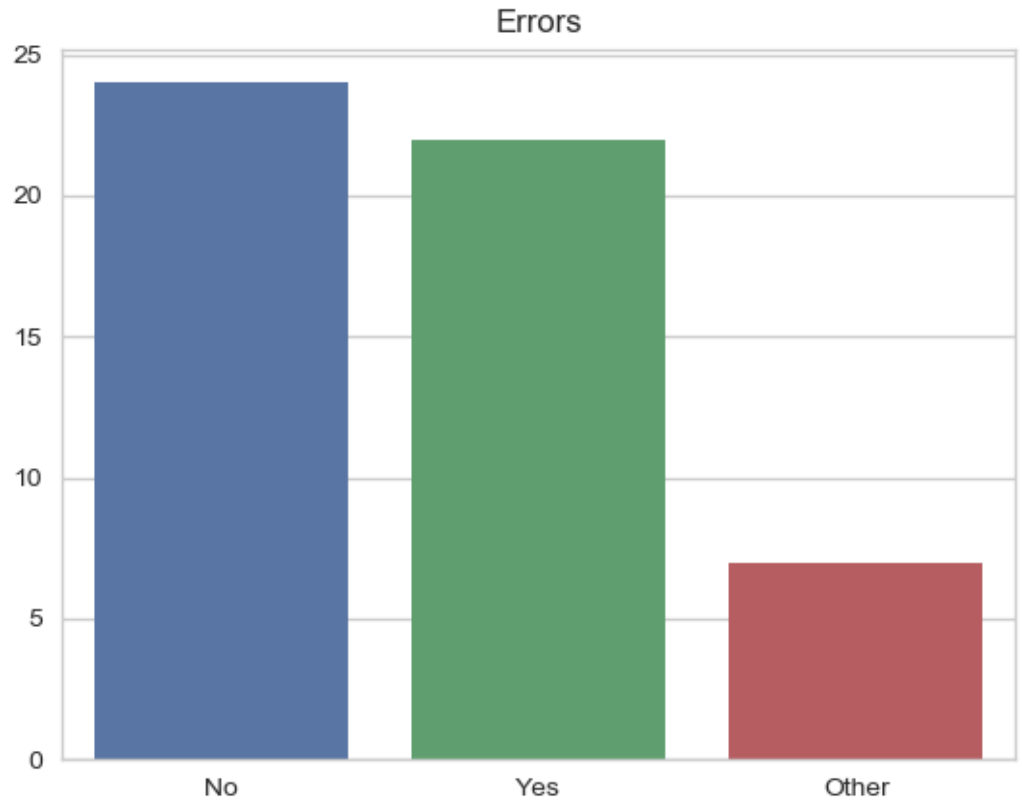


Approaches to conformance

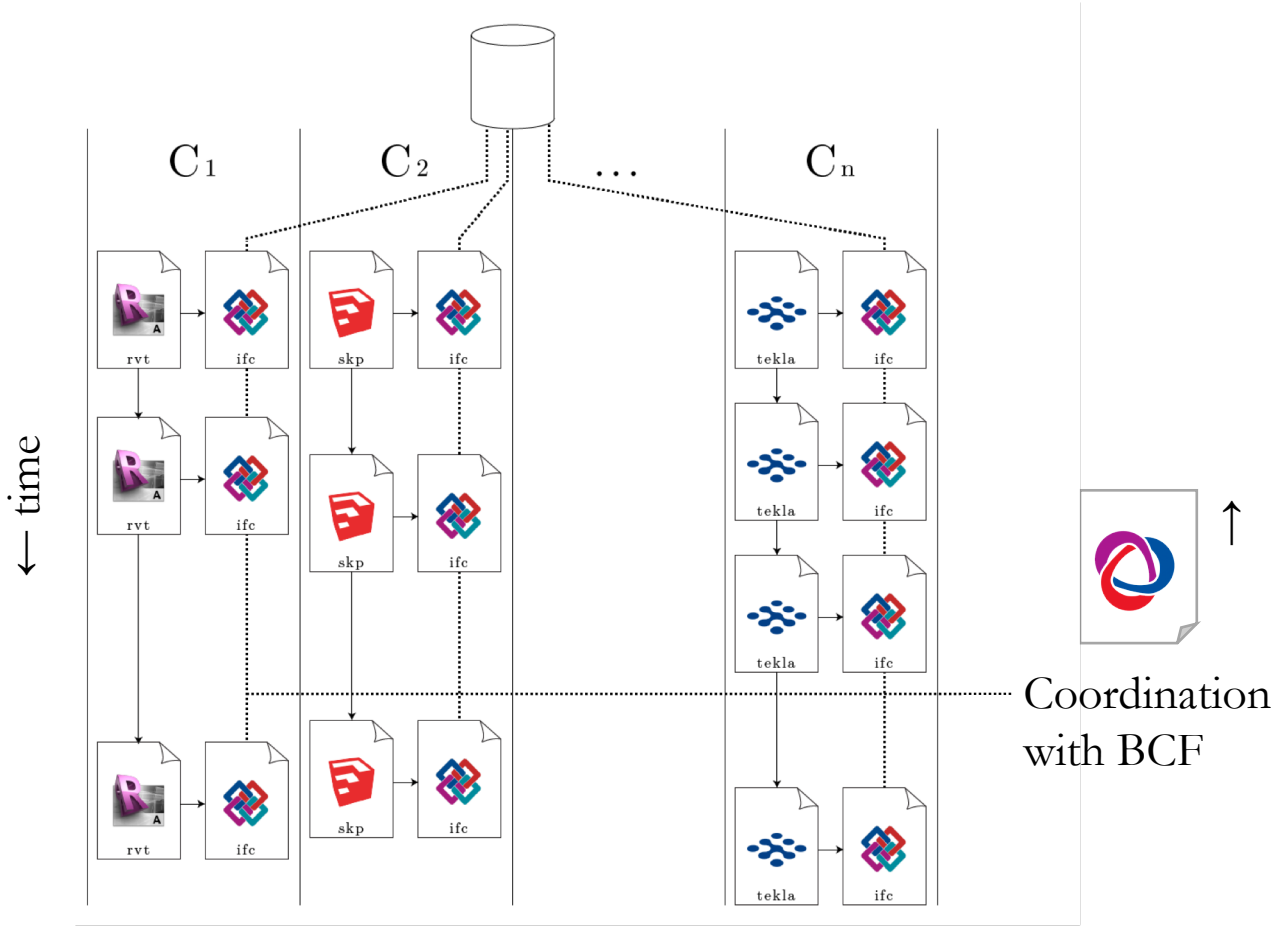


Benchmark question

56.1) Does the software reports any error during the import process?

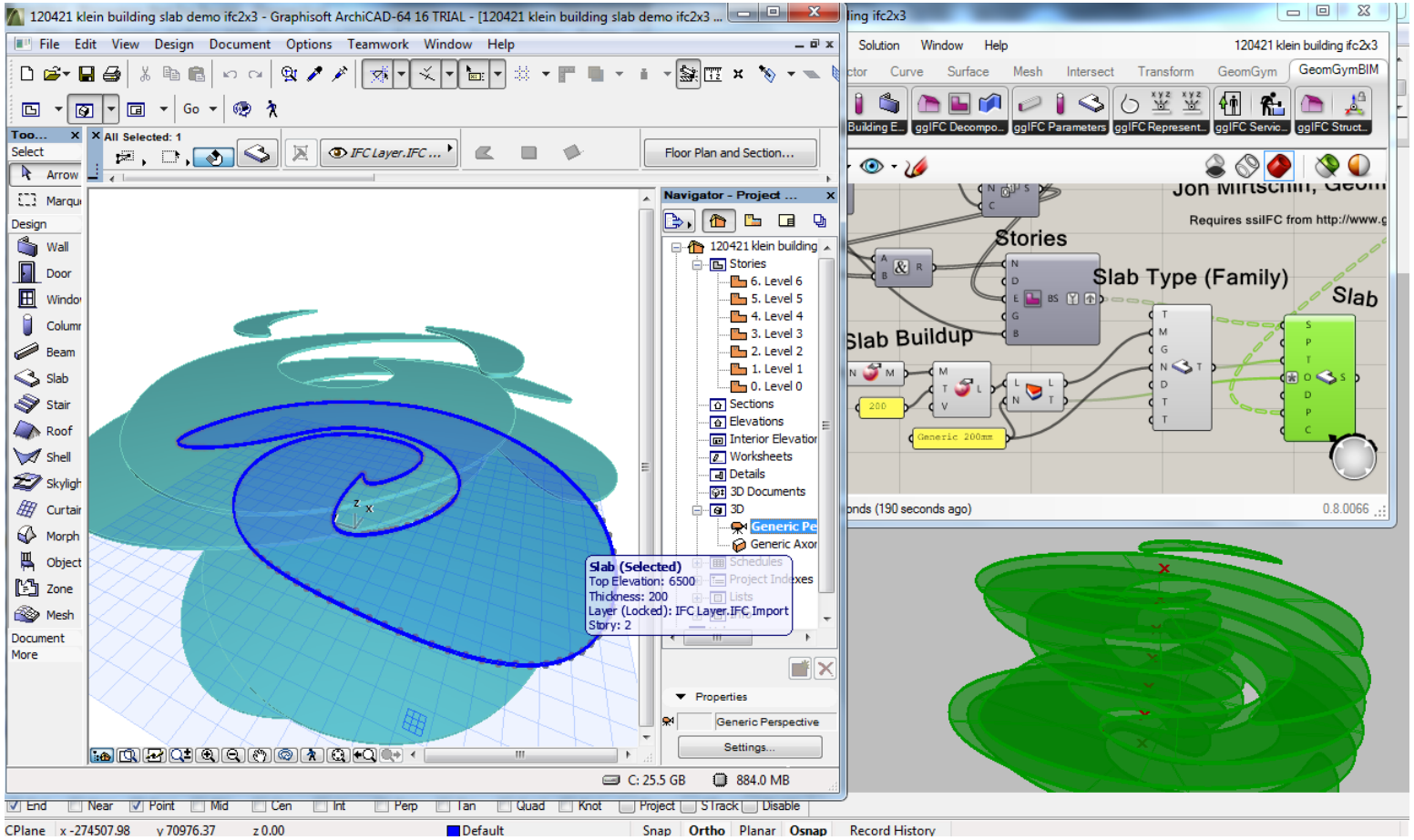


IFC for Coordination

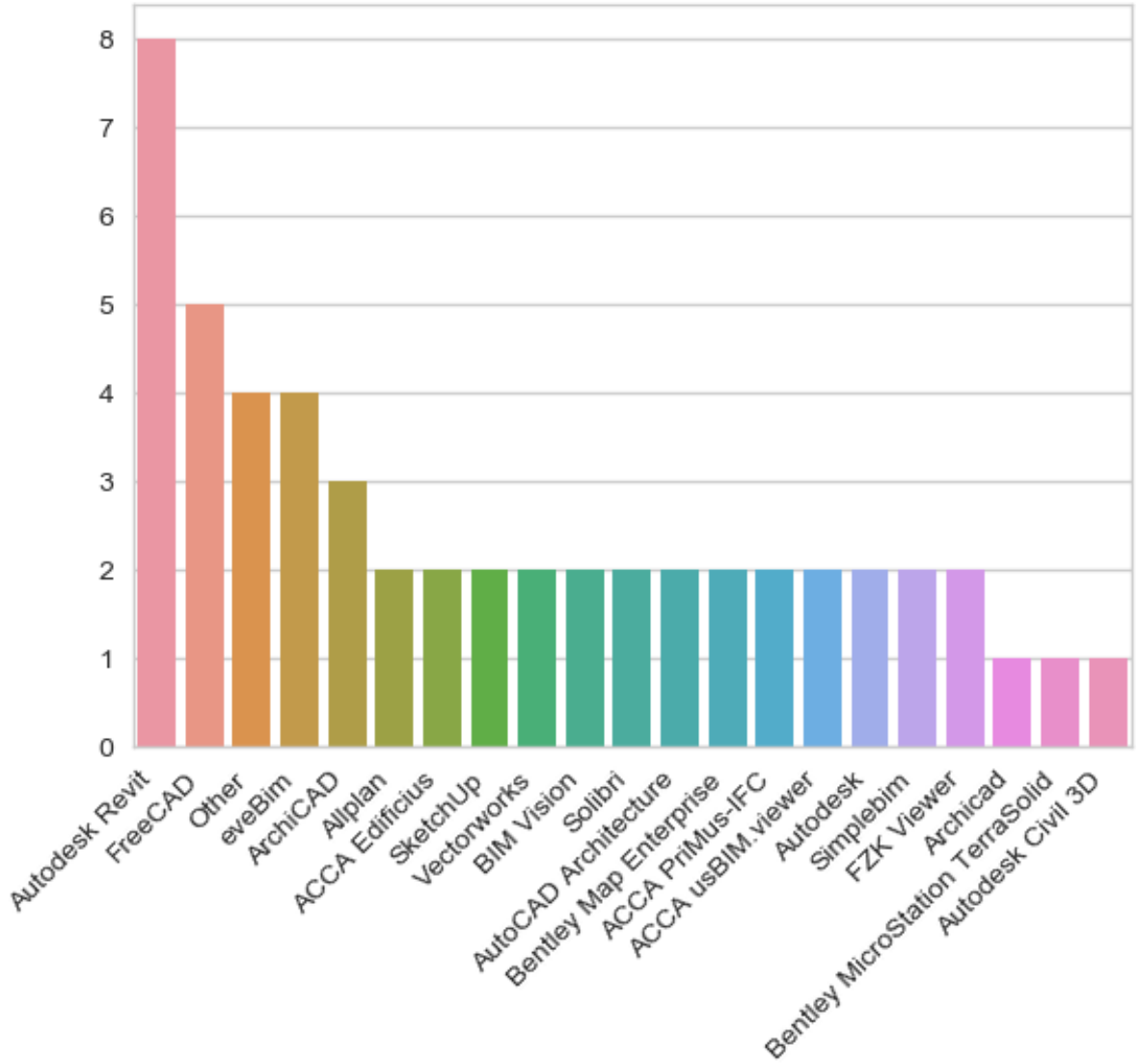


vs IFC for Design Transfer

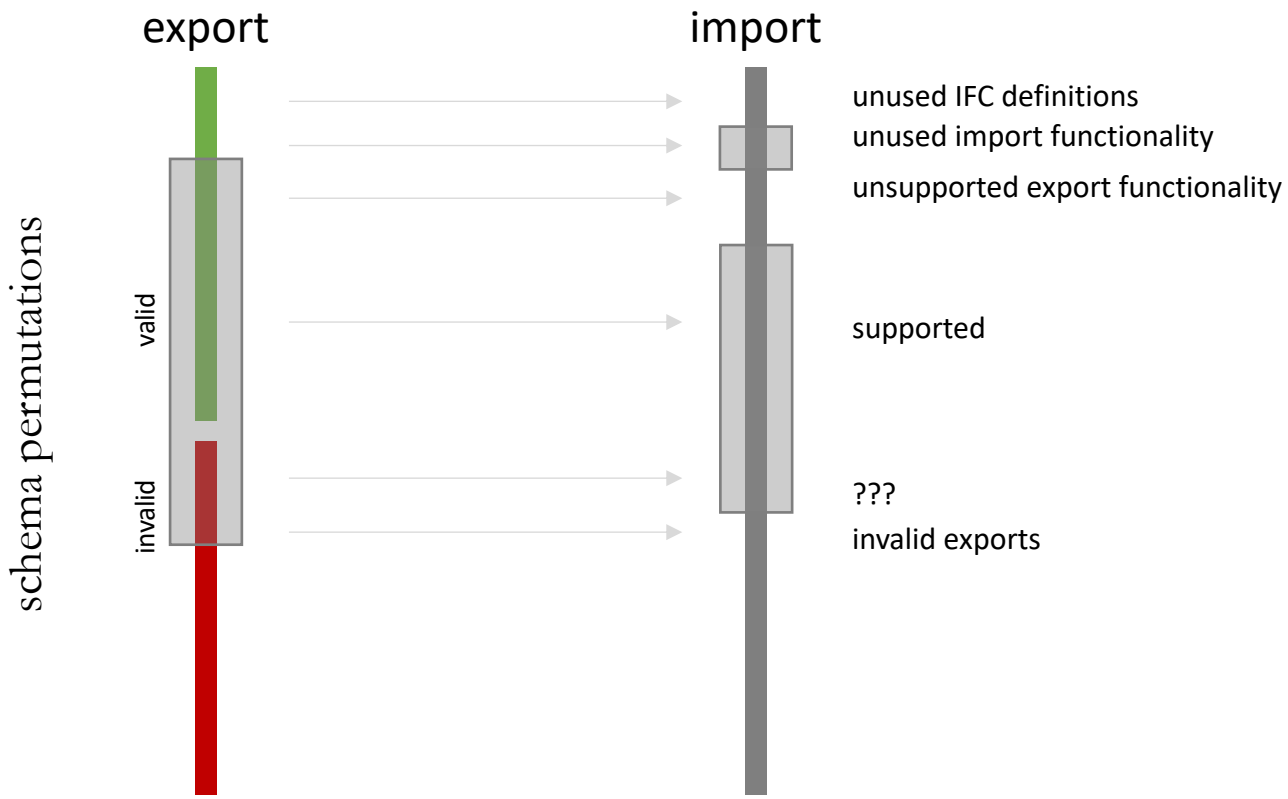
(source Jon Mirtschin geometrygym)



Benchmark software

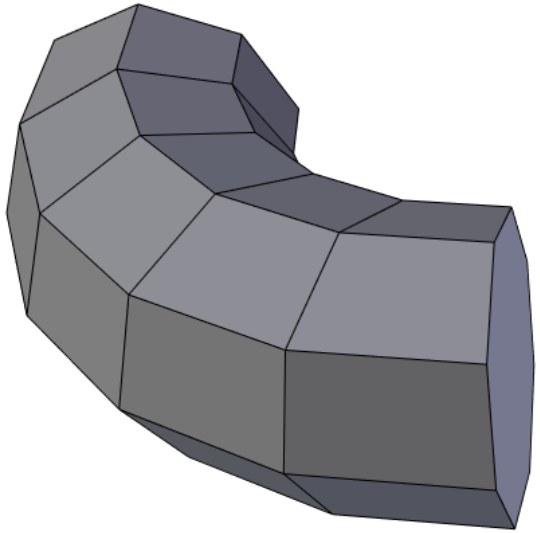


Benchmark task 1 aims



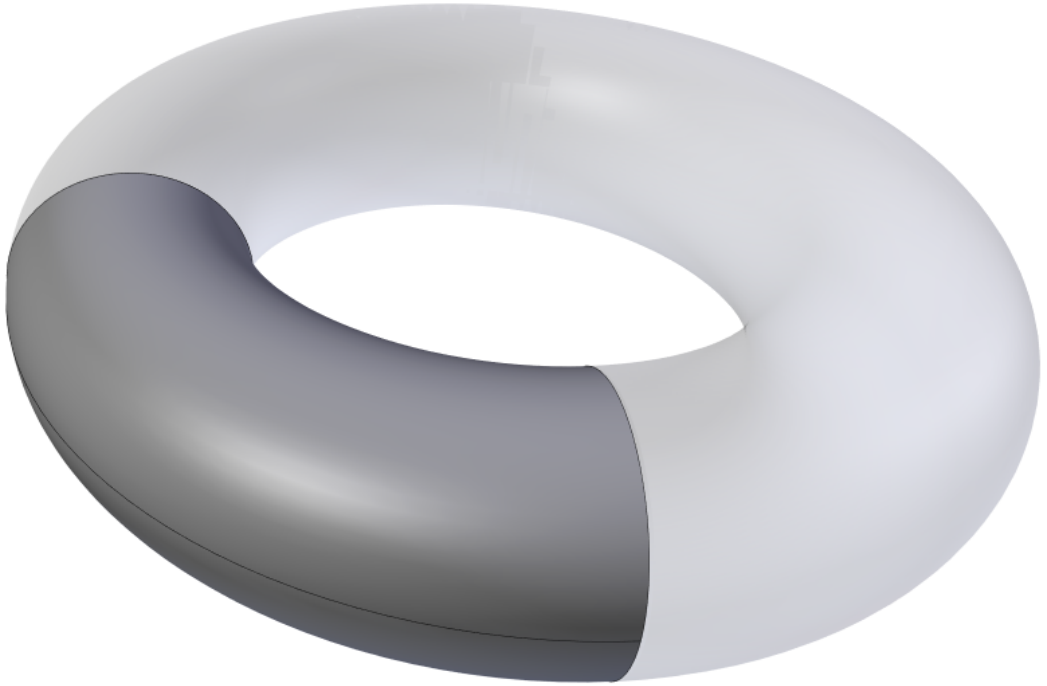
Implementations

Mesh/polyhedron vs. BRep



Generally more robust and generic

Some shapes are easier to represent, e.g. Tapered Revolution

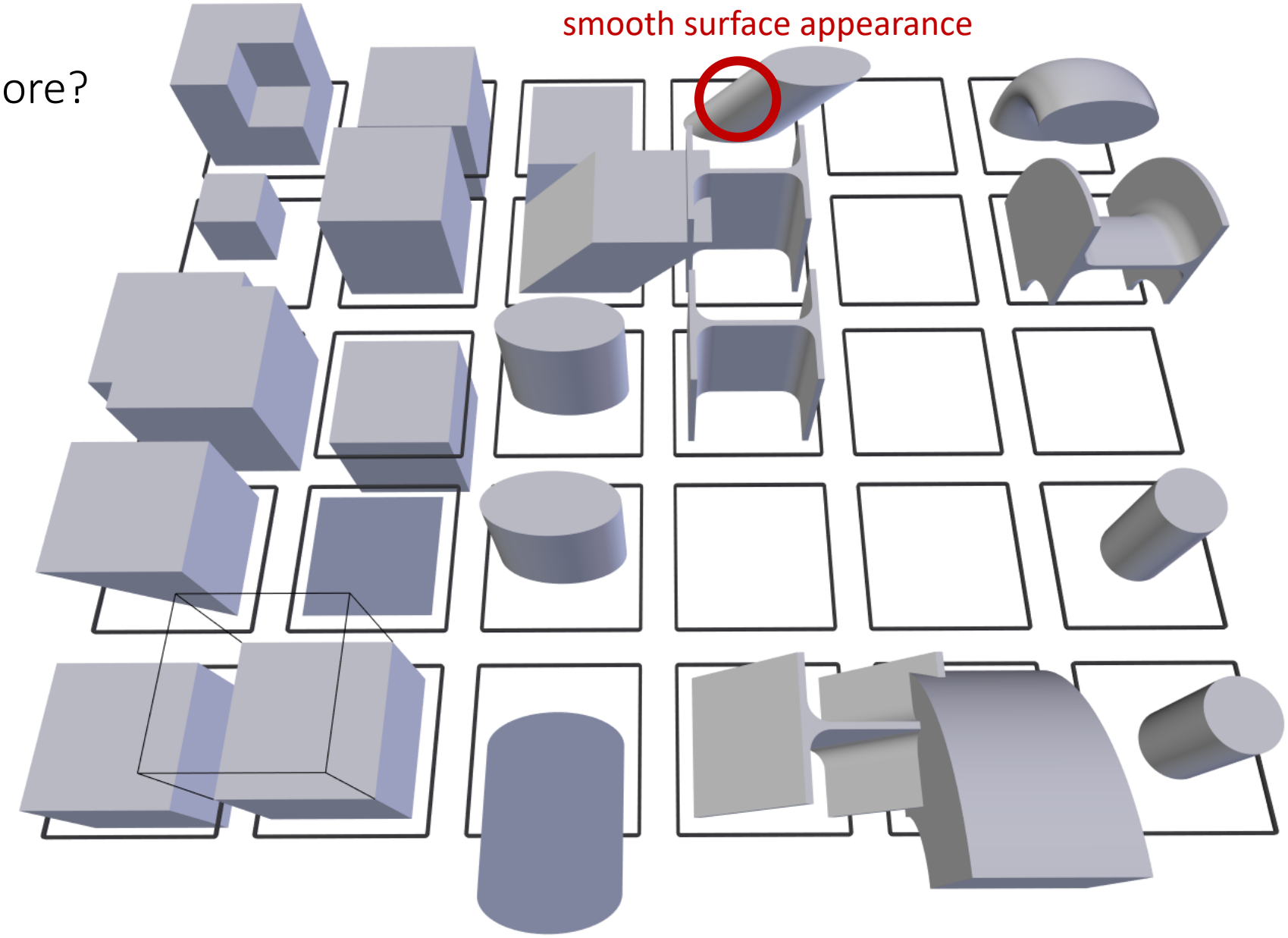


More semantics retained, e.g. Inner Outer radius of Toroidal surface

Typically higher fidelity as meshing for visualization is final step

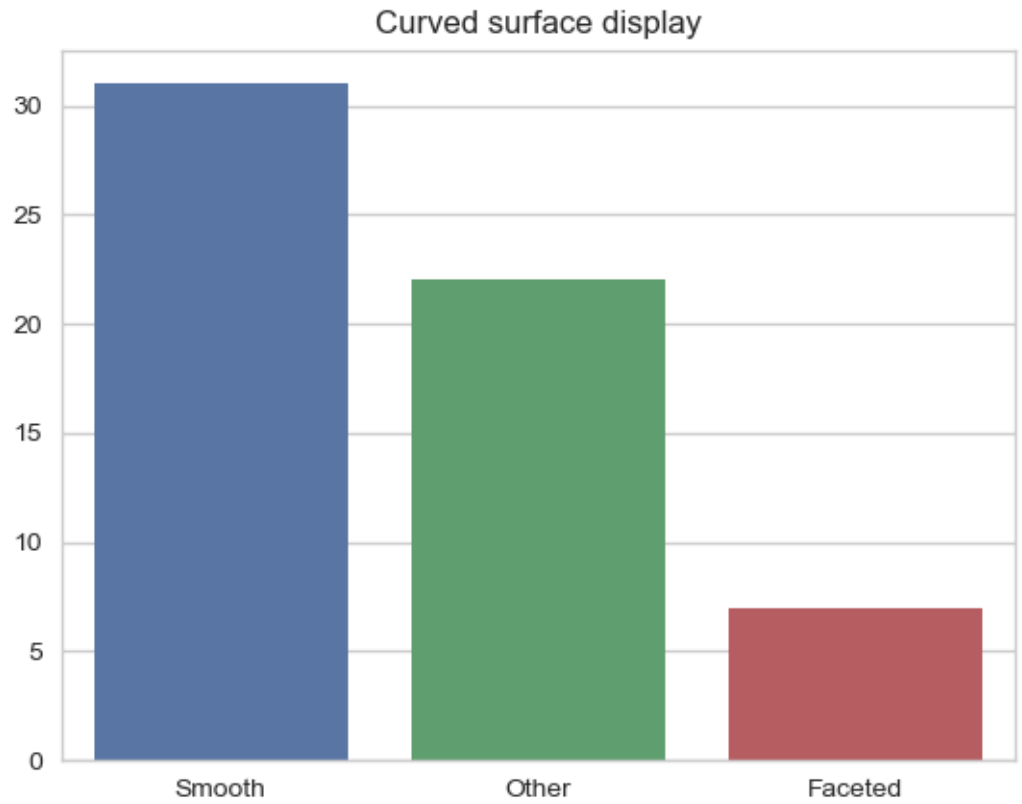
More precise analysis, interference, curvature radius

Less is more?



Benchmark question

70.13.1.2) How do the curved surfaces look?



Schema constraints

attribute type and cardinality

Schema

```
ENTITY IfcDirection
    DirectionRatios     : LIST [2:3] OF IfcReal;
END_ENTITY;
```

Instance

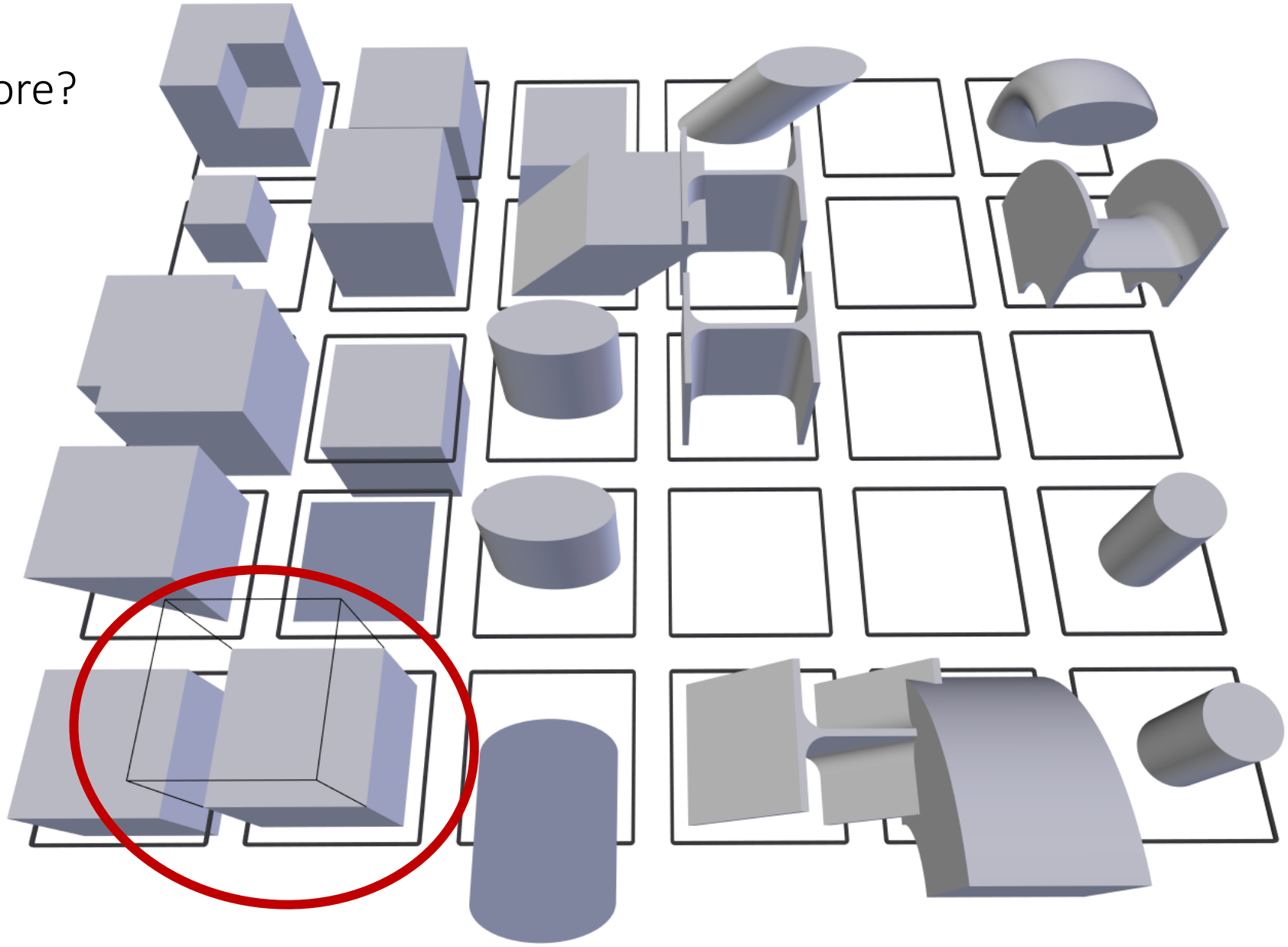
✗

```
IFCDIRECTION((0, 0, 1));
IFCDIRECTION((0.0, 0.0, 1.0, 0.0));
```

✓

```
IFCDIRECTION((0.0, 0.0, 1.0));
IFCDIRECTION((0.0, 0.0, 2.0));
```

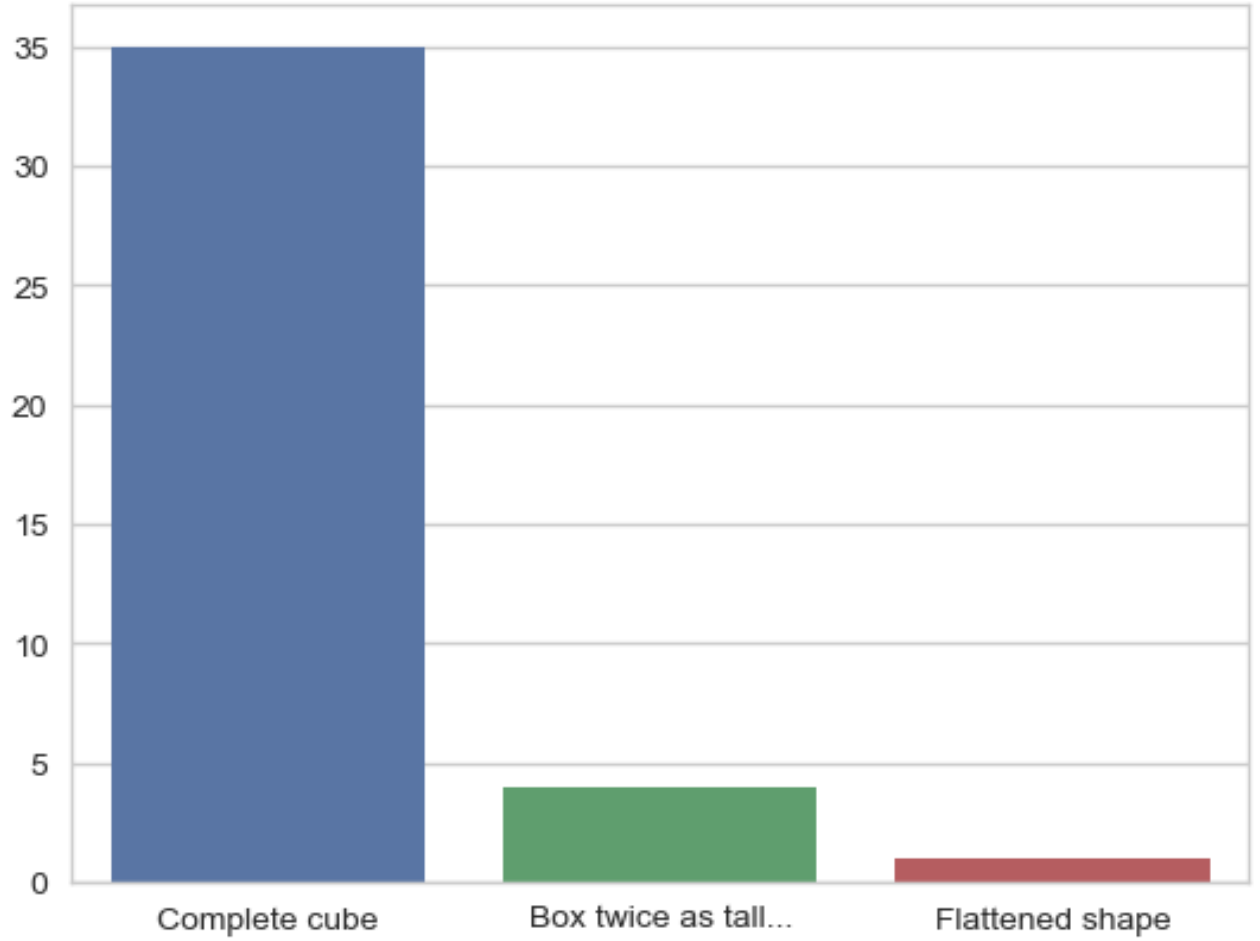
Less is more?



non-normalized
extrusion depth

Benchmark question

70.20.1.3) Which shape is shown?



Schema constraints

simple where rules

Schema

```
TYPE IfcPositiveLengthMeasure = IfcLengthMeasure;
 WHERE
    WR1 : SELF > 0.;
END_TYPE;

ENTITY IfcExtrudedAreaSolid;
  ENTITY IfcSweptAreaSolid;
    SweptArea         : IfcProfileDef;
    Position          : IfcAxis2Placement3D;
  ENTITY IfcExtrudedAreaSolid;
    ExtrudedDirection : IfcDirection;
    Depth             : IfcPositiveLengthMeasure;
   WHERE ValidExtrusionDirection :
     IfcDotProduct(IfcRepresentationItem() ||
       IfcGeometricRepresentationItem() ||
       IfcDirection([0.0,0.0,1.0]), SELF.ExtrudedDirection
     ) <> 0.0;
END_ENTITY;
```

Instance

```
IFCEXTRUDEDAREASOLID(#1, #2, #3, -1.0);
```

✗

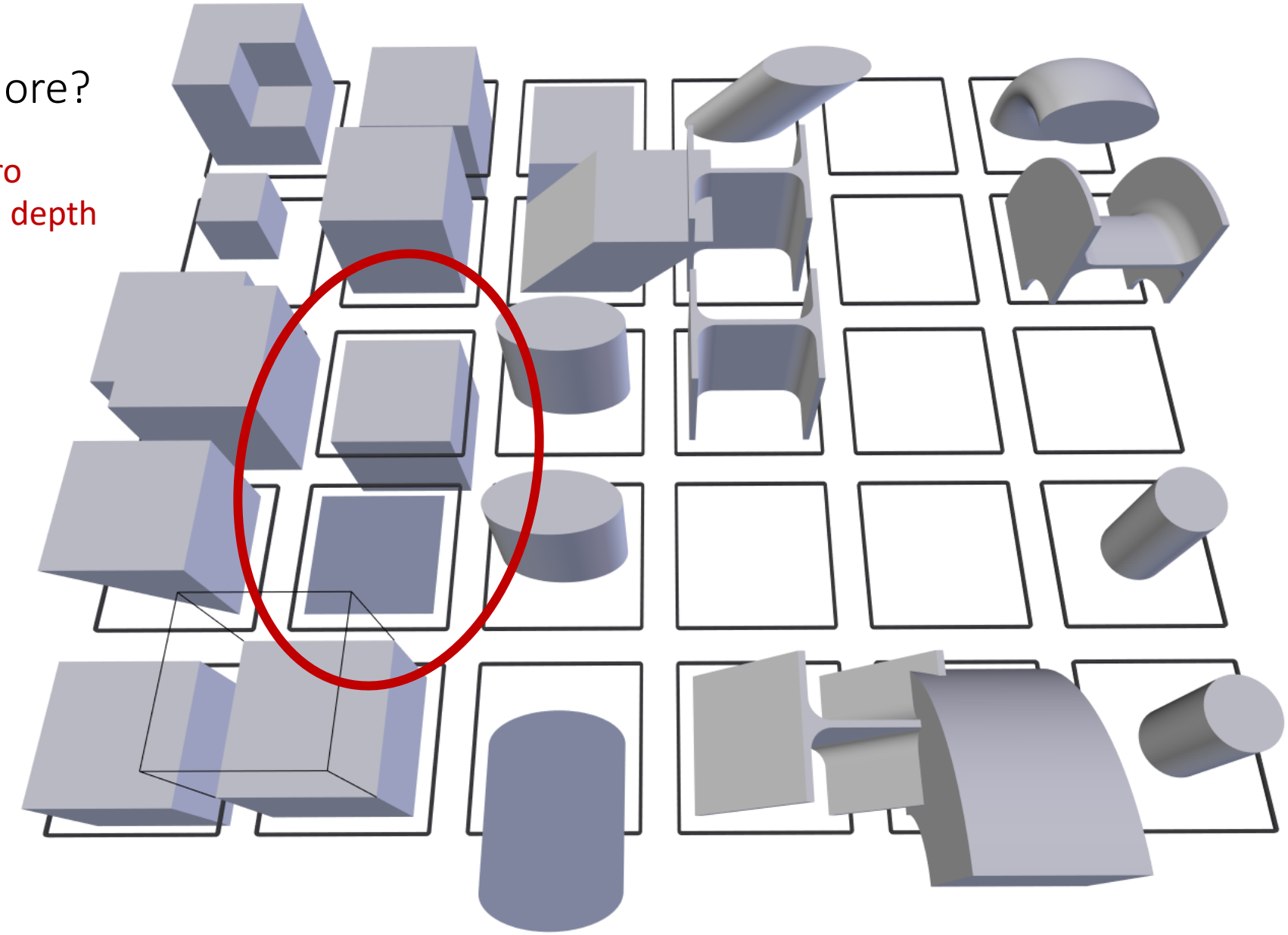
```
IFCEXTRUDEDAREASOLID(#1, #2, #3, 0.0);
IFCEXTRUDEDAREASOLID(#1, #2, #3, 5);
```

✓

```
IFCEXTRUDEDAREASOLID(#1, #2, #3, 1.0);
```

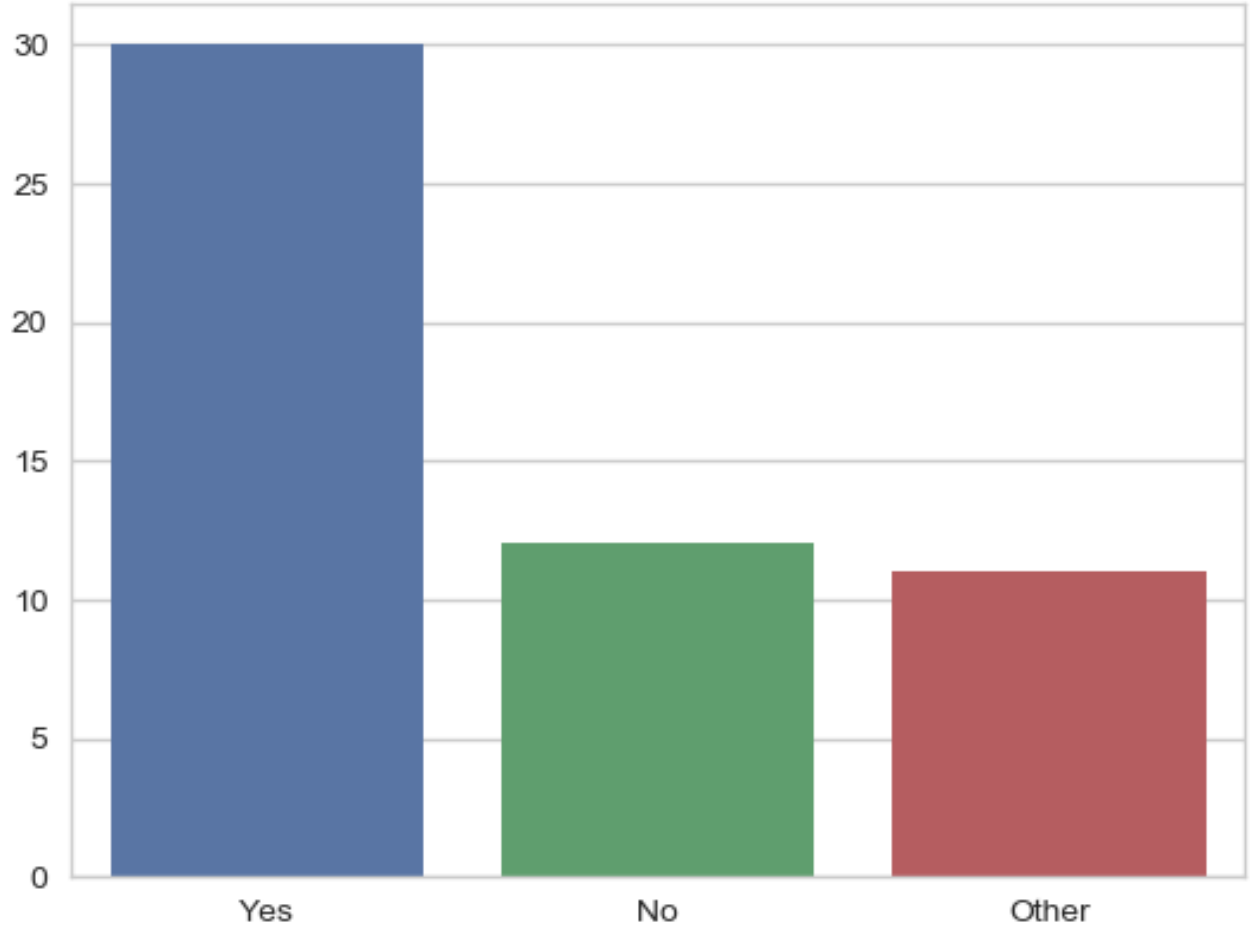
Less is more?

negative and zero
extent extrusion depth



Benchmark question

70.18.1) Is the object visible?



Schema constraints

complex where rules

Schema

```
TYPE IfcPositiveLengthMeasure = IfcLengthMeasure;
 WHERE
    WR1 : SELF > 0.;
END_TYPE;

ENTITY IfcExtrudedAreaSolid;
  ENTITY IfcSweptAreaSolid;
    SweptArea         : IfcProfileDef;
    Position          : IfcAxis2Placement3D;
  ENTITY IfcExtrudedAreaSolid;
    ExtrudedDirection : IfcDirection;
    Depth             : IfcPositiveLengthMeasure;
   WHERE ValidExtrusionDirection :
     IfcDotProduct(IfcRepresentationItem() ||
       IfcGeometricRepresentationItem() ||
       IfcDirection([0.0,0.0,1.0]), SELF.ExtrudedDirection
     ) <> 0.0;
END_ENTITY;
```

Instance

✗

```
#3 = IFCDIRECTION((1.0, 0.0, 0.0));
   = IFCEXTRUDEDAREASOLID(#1, #2, #3, 5);
```

✓

```
#3 = IFCDIRECTION((0.0, 0.0, 1.0));
   = IFCEXTRUDEDAREASOLID(#1, #2, #3, 5);
#3 = IFCDIRECTION((0.0, 0.0, 0.0000000001));
   = IFCEXTRUDEDAREASOLID(#1, #2, #3, 5);
#3 = IFCDIRECTION((0.0, 0.0, 1.0E-10000));
   = IFCEXTRUDEDAREASOLID(#1, #2, #3, 5);
```

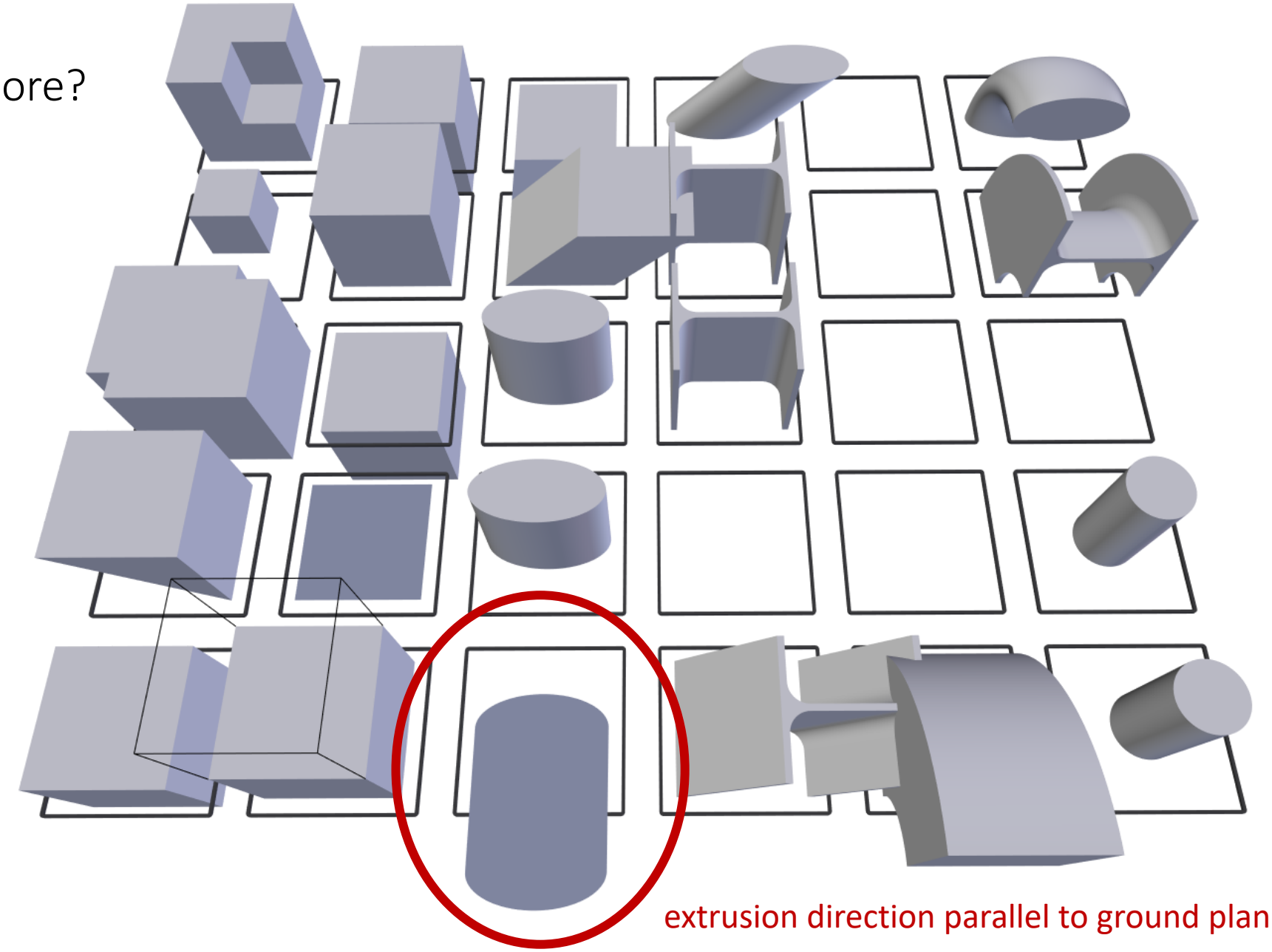
Schema constraints

complex where rules

Schema

```
FUNCTION IfcDotProduct
(Arg1, Arg2 : IfcDirection)
    : REAL;
LOCAL
  Scalar : REAL;
  Vec1, Vec2 : IfcDirection;
  Ndim   : INTEGER;
END_LOCAL;

  IF NOT EXISTS (Arg1) OR NOT EXISTS (Arg2) THEN
    Scalar := ?;
  ELSE
    IF (Arg1.Dim <> Arg2.Dim) THEN
      Scalar := ?;
    ELSE
      BEGIN
        Vec1 := IfcNormalise(Arg1);
        Vec2 := IfcNormalise(Arg2);
        Ndim := Arg1.Dim;
        Scalar := 0.0;
        REPEAT i := 1 TO Ndim;
          Scalar := Scalar + Vec1.DirectionRatios[i]*Vec2.DirectionRatios[i];
        END_REPEAT;
      END;
    END_IF;
  END_IF;
  RETURN (Scalar);
END_FUNCTION;
```

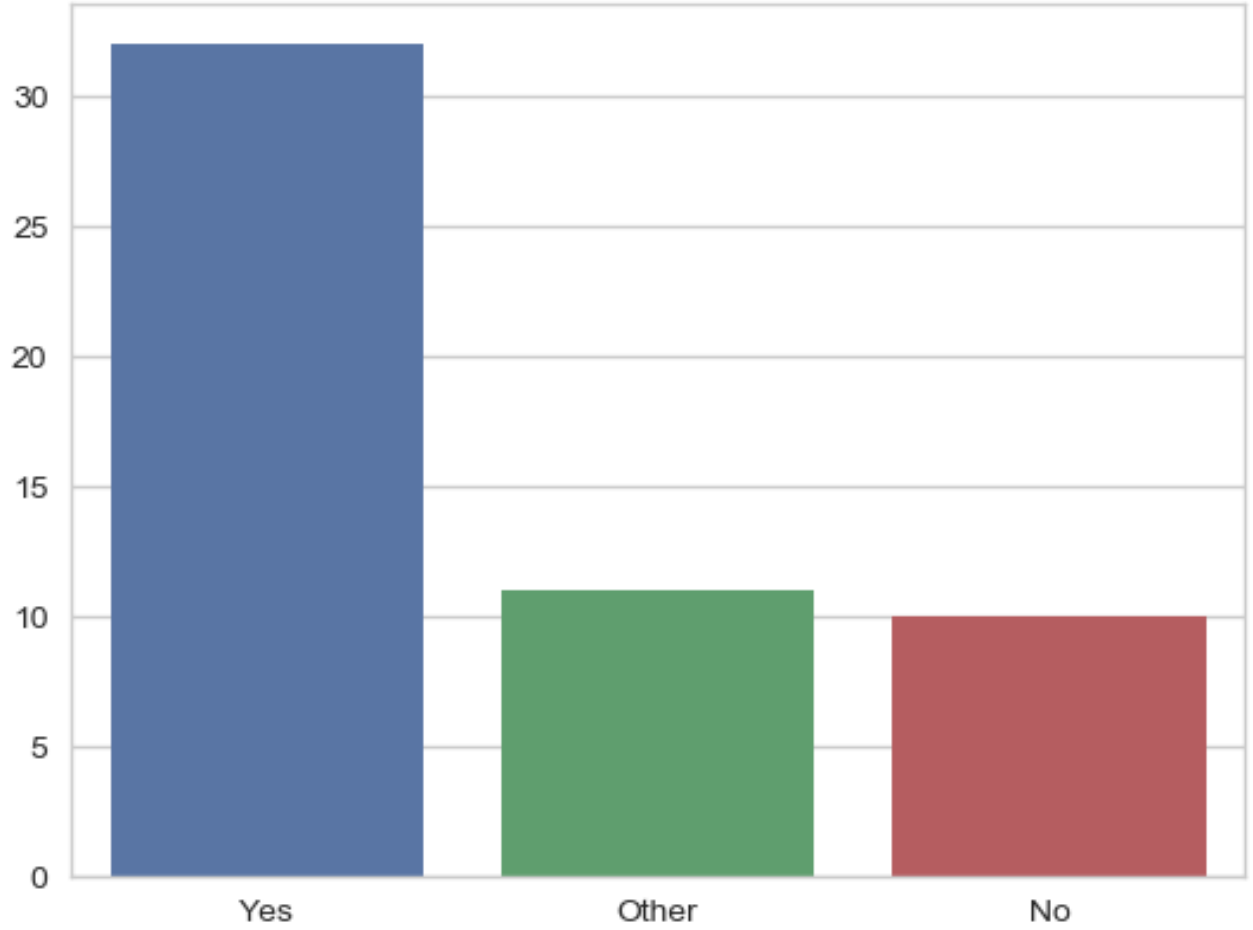
Less is more?



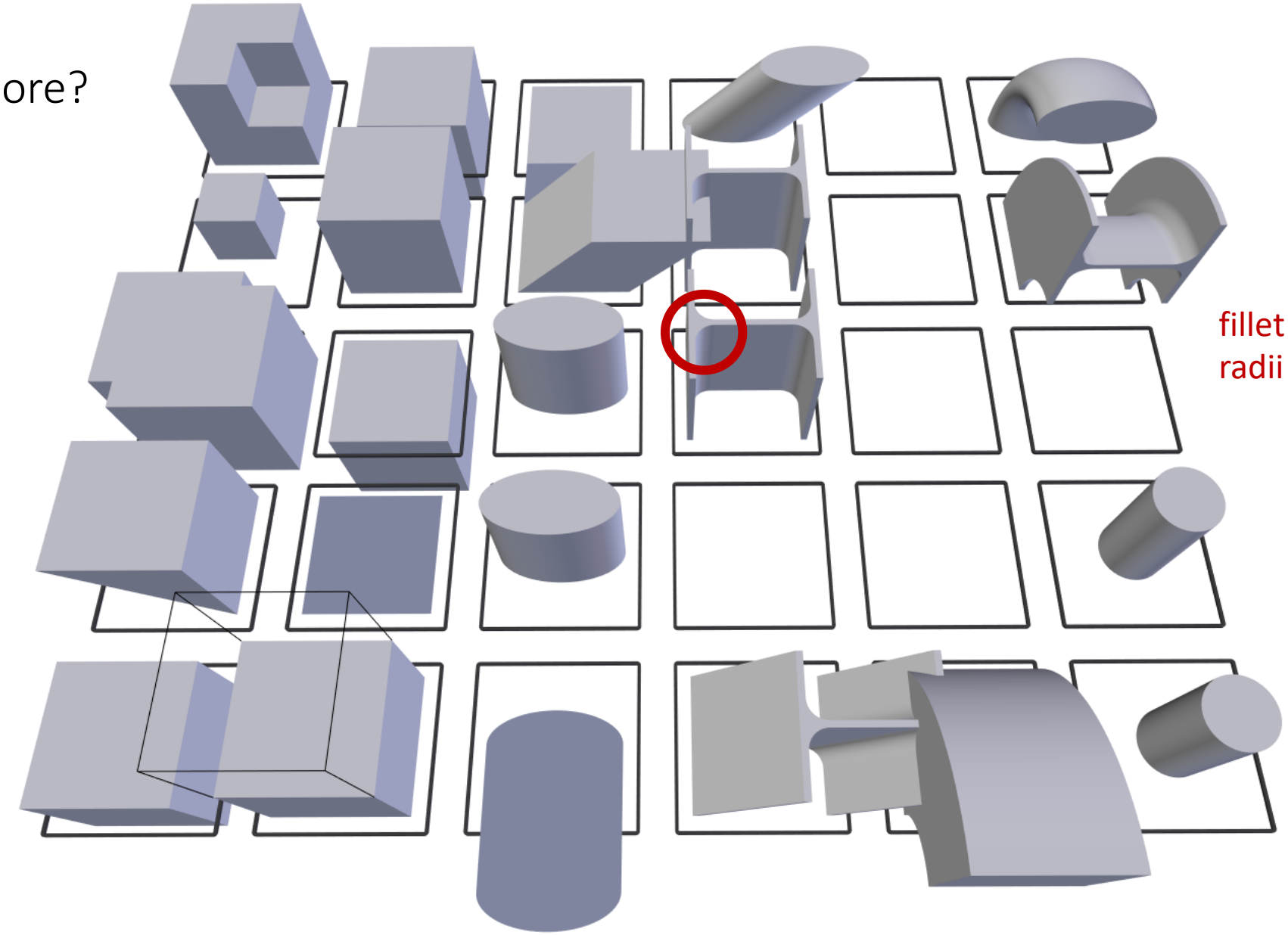
extrusion direction parallel to ground plane

Benchmark question

58.27.1) Is the object visible?

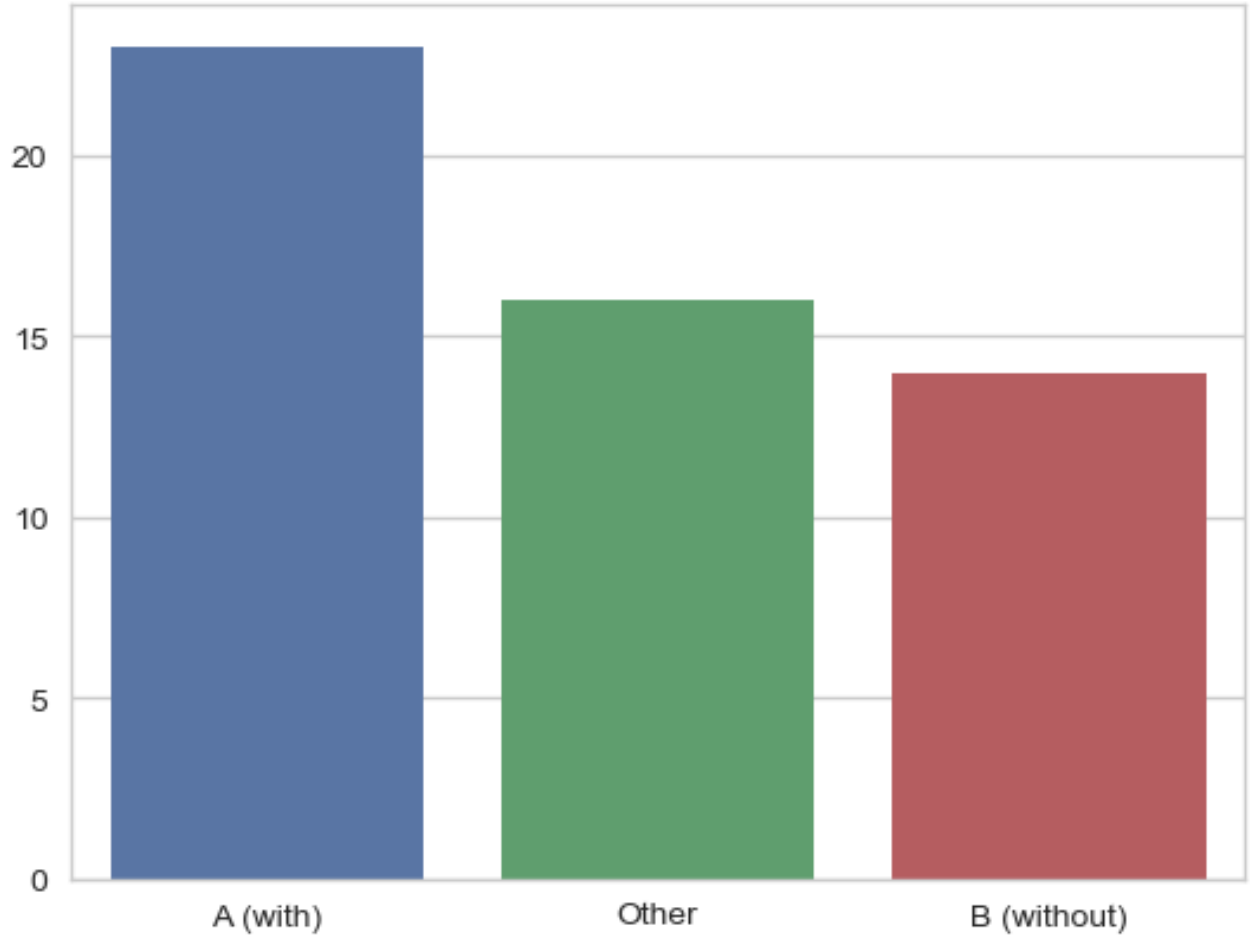


Less is more?



Benchmark question

58.10.1.3) Which shape is shown?

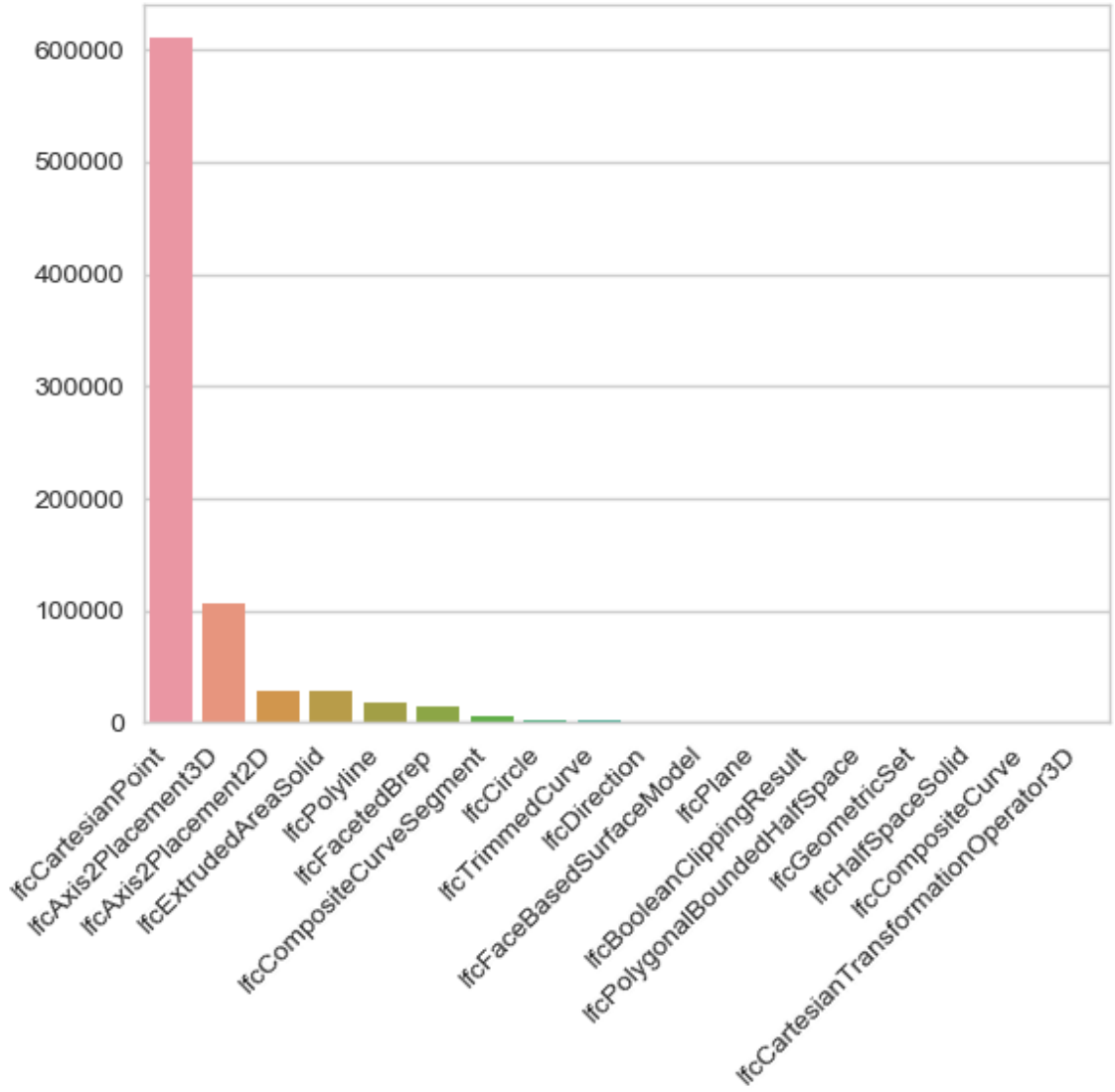


So how representative is the analytical set?

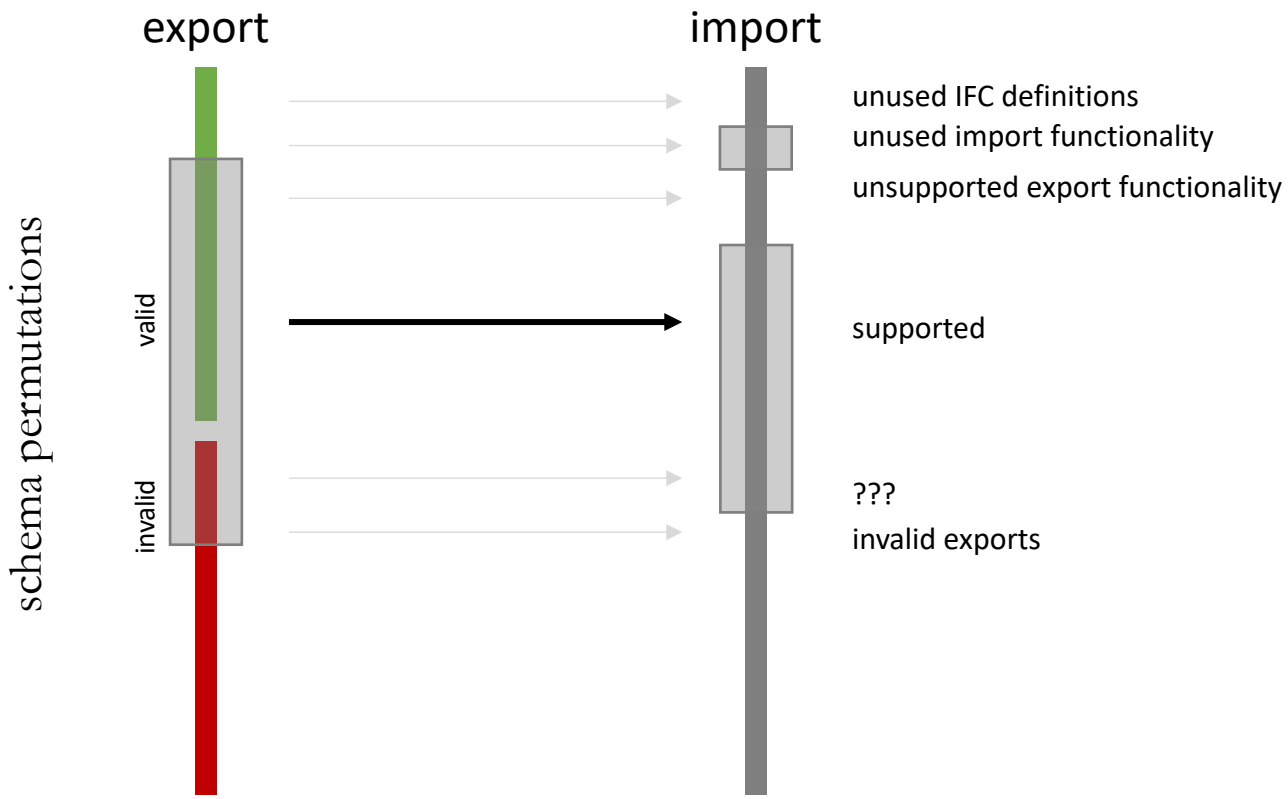
For example: UpTown.ifc inverse cardinality constraint violations

```
In #393649=IfcPropertySet('1aWRULhxj7bQvqMfYsERm8',#41,'Construction(Type)',$,(#393615)):

(#393565=IfcDoorStyle('2euSa6d3j2NfgnUIPichlH',#41,'std',$,$,(#393563,#393564,#393647,#393
649,#393651,#393653),(#393562),'2869064',.NOTDEFINED.,.USERDEFINED.,.F.,.F.),

#2286063=IfcDoorStyle('2euSa6d3j2NfgnUIPicgaL',#41,'std',$,$,(#393647,#393649,#393651,#393
653,#2286061,#2286062),(#2286060),'2869064',.NOTDEFINED.,.USERDEFINED.,.F.,.F.))

not valid for

<inverse DefinesType: set [0:1] of <entity IfcTypeObject> for <attribute HasPropertySets?:
<set [1:?] of <entity IfcPropertySetDefinition>>>>
```

So how representative is the analytical set?



Degradation to robustness over accuracy, efficiency, richness and parametricity

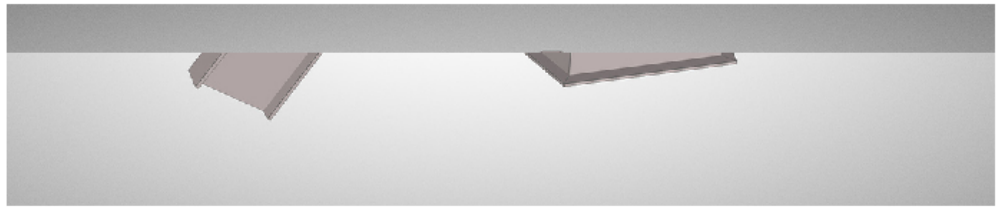


IfcSurfaceCurveSweptAreaSolid does not consistently orient the swept profile

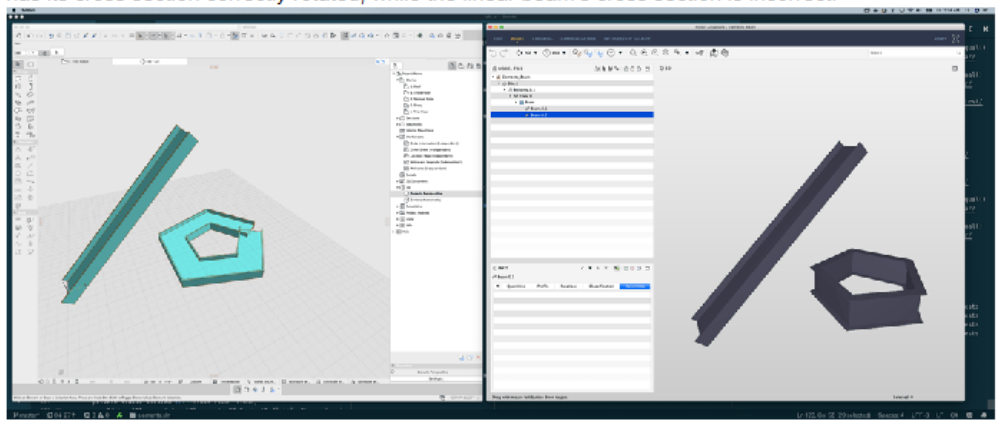
Developers - Implementation ifc4-errata

ian 3 Jun 21

I'm attempting to create beams which represent a cross section swept along a path. To do this, I'm using `IfcSurfaceCurveSweptAreaSolid`. The correct result should look like this:



The actual results can be seen below. On the left is ArchiCAD's interpretation where both beams have their cross section rotated incorrectly. On the right is Solibri where the sweep along the polygon path has its cross section correctly rotated, while the linear beam's cross section is incorrect.



In both cases, a reference surface is created which is a vertical extrude of the centerline of the beam. So according to the spec, the profiles should both be turned so that their local X axis is normal to that surface. Is this just a matter of incomplete/inconsistent vendor implementation of the spec, or is there more that I need to do to define the direction of the cross section profile?

UPDATE:
I've added a beam based on an arc using the same strategy, and Solibri gives a wonky result. I would

7d ago

Conclusions

Interpretation differences exist with regards to:

- handling of valid input
- reporting on invalid input

Due to:

- importer errors
- exporter errors
- schema unclarity

Thank you

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