

| Number | Object Category | Priority | Attribute Name     | IFC representation of the exchange   | Status of IFC implementation, model view definition, certification process   | MVD name   | Recommendations for ATC-75 implementation  | Recommendation for further IFC development   |
|--------|-----------------|----------|--------------------|--|--|--|--|--|
| 1      | STORY           |          |                    |  |  |  |  |  |
|        |                 | 2        | Story Elevation    | It is available as derived information from IFC. <i>IfcSite.Elevation</i> is the elevation about sea level using WGS84 <i>IfcBuilding.ElevationOfRefHeight</i> = Elevation above sea level of the reference height used for all storey elevation measures = all story elevation are given relative to this height. <i>IfcBuildingStorey.Elevation</i> = Elevation of the particular story against this reference height = Total height of story is <i>Elevation + ElevationOfRefHeight</i> | entities are part of the coordination view and certification, provision of these attributes is however not enforced.   | Story diagram<br>Site + Building + BuildingStorey + SpatialDecomposition | add the support for geographic locations (latitude, longitude, elevation above sea level to the implementation scope as an enforcement of the coordination view.                                       |  |
|        |                 | 2        | Story Name         | <i>IfcBuildingStorey.Name</i> , a string value to store the user/system defined name of the story. "Name" defined the story designator, In addition a "LongName" for a full text can be provided.  | part of Coordination view and certification. Should already be in scope of all implementations.  | VBL-025<br>VBL-171   | add to implementation scope as an enforcement of the coordination view.  |  |
| 2      | GRID            |          |                    |  |  |  |  |  |
|        |                 | 2        | Grid element       | <i>IfcGrid</i> entity in IFC is a line based grid consisting of pairs/rows of 2D lines in u, v directions.   | currently the support of grids is not enforced in the coordination view, add support for <i>IfcGrid</i> to the coordination view (as it is needed for coordination).   | Grid diagram   | verify support for <i>IfcGrid</i> assigned to different storeys  | add a new entity <i>IfcGrid3D</i> to IFC2x4  |
|        |                 | 2        | Grid layout        | not yet supported  |  |  |  |  |
|        |                 | 2        | Grid numbering     | supported for 2D grids, based on grid lines. Supported as <i>IfcGridAxis.AxisTag</i>   |  |  |  |  |
|        |                 | 2        | Reference to story | supported for 2D grids, based on grid lines. Supported as <i>IfcGrid.(INV)ContainedInStructure</i>   |  |  |  |  |
| 3      | COLUMN          |          |                    |  |  |  |  |  |
|        |                 | 1        | Column axis        | Additional <i>IfcShapeRepresentation</i> with <i>RepresentationType</i> = Axis. The <i>IfcGeometricRepresentationItem</i> is a single <i>IfcPolyline</i> (or <i>IfcTrimmedCurve</i> with <i>BaseCurve IfcLine</i> , or <i>IfcCircle</i> )  | Currently not enforced in the coordination view.   | "Axis Definition"  |  |  |
|        |                 | 1        | Profile Name       | For all parametric profiles and all extrusion based profiles it is currently provided as a single string value - <i>IfcProfileDef.ProfileName</i> .<br><br>Need some additional agreement where a section designator (plus eventually a section table name) goes in IFC file for any type of geometry representation, e.g. in case of BREP or <i>SurfaceModels</i> .   | The entity <i>IfcProfileDef</i> (it's subtypes) is already required as part of the Coordination view and certification. Filling the attribute <i>ProfileName</i> (with sensible values) is however not yet enforced.<br><br>It should be enforced, if such information is available in the authoring tool. | "Profile Definition"<br>- see also "Single Value Property Definition"    | use the "Profile Definition" agreement for all <i>SweptSolid</i> 's. Agree to use AISC naming convention as far as applicable. Add to implementation scope as an enforcement of the coordination view. | add a general place to find a profile name and section table name independently of the profile geometry. For now profile names should be passed as a property set, as it cannot be added to a <i>brep</i> column. Better support to be added in IFC2x4 |
|        |                 | 1        | Material Name      | <i>IfcMaterial.Name</i> - it is currently the only string value applicable for material name. There is no distinction between a material name as general name and material category (steel, column, timber, etc.)  | Support of <i>IfcMaterial.Name</i> is part of the coordination view and enforced. A separate field for the material category is not yet provided.  | VBL-345<br>VBL-265   | Support of material name added to implementation scope as an enforcement of the coordination view.   | Add a second attribute in IFC2x4 to differentiate a user name for any material and the material category.  |
|        |                 | 1        | Grade              | Currently there is no specific attribute for grade, it should be handled by material classification (grade name "36" and referenced standard "ASTM". It would be represented by <i>IfcMaterial.(INV)ClassifiedAs</i> and <i>IfcClassificationReference</i> .   | Not part of the coordination view. Can be added for this testbed.  | "Material Grade"   | Support of material classification added to implementation scope.  |  |

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|--------|-----------------|----------|-----------------------------|---|--|--|---|---|
|        |                 | 1        | <b>Length</b>               | Lenght is perceived in IFC as a quantity, i.e. it is a measurement taken from the geometry that should be exchanged in addition to the geometric representation. Such quantities should be added for downstream applications (not having an own geometric kernel). In this use case it could be expected from the receiving application to reestablish:<br>- (physical) length from the extrusion length<br>- logical length from the length of the axis representation<br>Simple Quantity (using <i>IfcQuantityLength</i> with the Name 'Length'), optionally a "LogicalLength" can be supported in addition.        | export of quantities are part of the "QTO view", which is an add on to the coordination view (and not a part).<br>export of an additional axis representation of the column is currently optional in the coordination view.  | "Single Quantity" also see QTO implementation guide. | Export of quantities is in scope of the QTO addon view. It should be added to implementation scope.   |   |
|        |                 | 1        | <b>Roll</b>                 | Roll is a redundant information given in addition to the geometric representation, but helpful for analysing the model, it should be provided as a property, similar to the Span property in Pset_ColumnCommon  | Currently not part of the Pset_ColumnCommon, should be added as a new property. Can be added for this testbed.   | "Single Value Property Definition"                   | Single Value Property Definition (principle of property definition that is needed here, property name would be 'Roll' with an value of the type <i>IfcPlaneAngleMeasure</i> ; <i>IfcPropertySet.Name</i> = 'Pset_ColumnCommon') | add Roll to Pset_ColumnCommon for IFC2x4                                    |
|        |                 | 1        | <b>Cardinal point</b>       |   | The cardinal point is currently not supported in IFC2x3, ist support is already proposed for IFC2x4.   | - not in 2x3 -                                       | not included, new schema IFC2x4 is required to support it.  | add CardinalPoint to IFC2x4 as part of the new material-profile definition. |
|        |                 | 1        | <b>Element ID</b>           | the element-id is not identical to the GUID, it is a unique number, given by the exporting software system, like a handle. The IFC representation is <i>IfcColumn.Tag</i> - see ist definition:<br><i>Tag</i> : The tag (or label) identifier at the particular instance of a product, e.g. the serial number, or the position number. It is the identifier at the occurrence level.  | Currently supported in an ambiguous way, e.g. as part of the <i>IfcColumn.Name</i> - need to be unified.   |  | Provide an unambiguous way to export the element ID, recommended is <i>IfcColumn.Tag</i> .  |   |
|        |                 | 2        | <b>Schedule Mark</b>        | the schedule mark is also regarded as reference id, or construction type id - it is already included in IFC as <i>Pset_ColumnCommon.Reference</i>   | Currently not supported in an unambiguous way.   |  | Provide an unambiguous way to export the schedule mark by using <i>Pset_ColumnCommon.Reference</i>  |   |
|        |                 | 2        | <b>Base Reference Story</b> | Is used for the containment information, i.e. the assignment of building elements (column, beam, wall, slab, ...) to spatial structure elements (typically the building story).   | Supported by the coordination view. It might not show up in the GUI of the receiving application - in this case implementation has to be improved.   | "Spatial Container"                                  | Include and verify it.  |   |
|        |                 | 2        | <b>Top Reference Story</b>  | May evaluate the containment information and the spatial structure. Requires to follow some references and may to check the geometry (length and offset of the column, reference high of the building storeys).   | Not currently supported in the coordination view, the IFC relationship, <i>IfcRelReferencedInSpatialStructure</i> would support it, but would need to be added to the coordination view.   | "Referenced in Spatial Structure"                    | Propose an addition to the view definition with an implementation guideline for capturing the top reference storey.   |   |
|        |                 | 2        | <b>Base Offset</b>          | The offset can be calculated from the element geometry. Please note that building elements (column, beam, wall, slab) are typically placed relative to their spatial container (see <i>Base Reference.Story</i> ) so that offset calculation is often very simple. However, the most general case might requires a sum of some offsets (1) offset of the base reference to the local placement of the building story + 2) offset of the local placements of the building story and the building element + 3) offset of the base level of the building element to its local placement) and coordinate transformations. | The information itself (reference to storey, relative placement to storey and placement of column extrusion body within the object placement) is part of the coordination view. It has however not be verified nor enforced to be interpreted as vertical base offset. |  |   |   |
|        |                 | 2        | <b>Top Offset</b>           | see <i>Base Offset</i> and <i>Top Reference.Story</i>   | depends on the clarification of the above requirements   |  |   |   |
| 4      | BEAM            |          |                             |   |  | Beam diagram   |   |   |

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|        |                 | 1        | <b>Beam Axis</b>      | Additional <i>IfcShapeRepresentation</i> with <i>RepresentationType</i> = Axis. The <i>IfcGeometricRepresentationItem</i> is a single <i>IfcPolyline</i> (or <i>IfcTrimmedCurve</i> with <i>BaseCurve IfcLine</i> , or <i>IfcCircle</i> )  | Currently not enforced in the coordination view.   | "Axis Definition"   |   |   |
|        |                 | 1        | <b>Profile Name</b>   | For all parametric profiles and all extrusion based profiles it is currently provided as a single string value - <i>IfcProfileDef.ProfileName</i> .<br><br>Need some additional agreement where a section designator (plus eventually a section table name) goes in IFC file for any type of geometry representation, e.g. in case of BREP or <i>SurfaceModels</i> .   | The entity <i>IfcProfileDef</i> (it's subtypes) is already required as part of the Coordination view and certification. Filling the attribute <i>ProfileName</i> (with sensible values) is however not yet enforced.<br><br>It should be enforced, if such information is available in the authoring tool. | "Profile Definition"<br>- see also "Single Value Property Definition" | use the "Profile Definition" agreement for all <i>SweptSolid</i> 's. Agree to use AISC naming convention as far as applicable. Add to implementation scope as an enforcement of the coordination view.                          | add a general place to find a profile name and section table name independently of the profile geometry. For now profile names should be passed as a property set, as it cannot be added to a <i>brep beam</i> . Better support to be added in IFC2x4 |
|        |                 | 1        | <b>Material Name</b>  | <i>IfcMaterial.Name</i> - it is currently the only string value applicable for material name. There is no distinction between a material name as general name and material category (steel, column, timber, etc.)  | Support of <i>IfcMaterial.Name</i> is part of the coordination view and enforced. A separate field for the material category is not yet provided.  | VBL-345<br>VBL-265  | Support of material name added to implementation scope as an enforcement of the coordination view.  | Add a second attribute in IFC2x4 to differentiate a user name for any material and the material category.   |
|        |                 | 1        | <b>Grade</b>          | Currently there is no specific attribute for grade, it should be handled by material classification (grade name "36" and referenced standard "ASTM". It would be represented by <i>IfcMaterial.(INV)ClassifiedAs</i> and <i>IfcClassificationReference</i> .   | Not part of the coordination view. Can be added for this testbed.  | "Material Grade"  | Support of material classification added to implementation scope.   |   |
|        |                 | 1        | <b>Length</b>         | Length is perceived in IFC as a quantity, i.e. it is a measurement taken from the geometry that should be exchanged in addition to the geometric representation. Such quantities should be added for downstream applications (not having an own geometric kernel). In this use case it could be expected from the receiving application to reestablish:<br>- (physical) length from the extrusion length<br>- logical length from the length of the axis representation<br>Simple Quantity (using <i>IfcQuantityLength</i> with the Name 'Length'), optionally a "LogicalLength" can be supported in addition. | export of quantities are part of the "QTO view", which is an add on to the coordination view (and not a part).<br>export of an additional axis representation of the column is currently optional in the coordination view.  | "Single Quantity"<br>also see QTO implementation guide.               | Export of quantities is in scope of the QTO addon view. It should be added to implementation scope.   |   |
|        |                 | 1        | <b>Roll</b>           | Roll is a redundant information given in addition to the geometric representation, but helpful for analysing the model, it should be provided as a property, similar to the <i>Span</i> property in <i>Pset_ColumnCommon</i>   | Currently not part of the <i>Pset_ColumnCommon</i> , should be added as a new property. Can be added for this testbed.   | "Single Value Property Definition"                                    | Single Value Property Definition (principle of property definition that is needed here, property name would be 'Roll' with an value of the type <i>IfcPlaneAngleMeasure</i> ; <i>IfcPropertySet.Name</i> = 'Pset_ColumnCommon') | add Roll to <i>Pset_ColumnCommon</i> for IFC2x4   |
|        |                 | 1        | <b>Cardinal point</b> |  | The cardinal point is currently not supported in IFC2x3, ist support is already proposed for IFC2x4.   | - not in 2x3 -  | not included, new schema IFC2x4 is required to support it.  | add <i>CardinalPoint</i> to IFC2x4 as part of the new material-profile definition.  |
|        |                 | 1        | <b>Element ID</b>     | the element-id is not identical to the GUID, it is a unique number, given by the exporting software system, like a handle. The IFC representation is <i>IfcBeam.Tag</i> - see ist definition:<br><i>Tag</i> : The tag (or label) identifier at the particular instance of a product, e.g. the serial number, or the position number. It is the identifier at the occurrence level.   | Currently supported in an ambiguous way, e.g. as part of the <i>IfcBeam.Name</i> - need to be unified.   |   | Provide an unambiguous way to export the element ID, recommended is <i>IfcBeam.Tag</i> .  |   |
|        |                 | 2        | <b>Schedule Mark</b>  |  | Currently not supported in an unambiguous way.   |   | Provide an unambiguous way to export the schedule mark by using <i>Pset_BeamCommon.Reference</i>  |   |

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|        |                 | 2        | <b>Base Reference Story</b>  | Is used for the containment information, i.e. the assignment of building elements (column, beam, wall, slab, ...) to spatial structure elements (typically the building story).   | Supported by the coordination view. It might not show up in the GUI of the receiving application - in this case implementation has to be improved.   |  | Propose an addition to the view definition with an implementation guideline for capturing the top reference storey.  |  |
|        |                 | 2        | <b>Vertical Start Offset</b> | <i>The offset can be calculated from the element geometry. Please note that building elements (column, beam, wall, slab) are typically placed relative to their spatial container (see Base Reference.Storey) so that offset calculation is often very simple. However, the most general case might requires a sum of some offsets 1) offset of the local placements of the building story and the building element + 2) offset of the base level of the building element to its local placement) and coordinate transformations.</i> | The information itself (reference to storey, relative placement to storey and placement of column extrusion body within the object placement) is part of the coordination view. It has however not be verified nor enforced to be interpreted as vertical base offset.                                     |  | Add an implematation guide on how to re-generate the offset exported as part of the local placement and geometric representation.  |  |
|        |                 | 2        | <b>Vertical End Offset</b>   | <i>The offset can be calculated from the element geometry. Please note that building elements (column, beam, wall, slab) are typically placed relative to their spatial container (see Base Reference.Storey) so that offset calculation is often very simple. However, the most general case might requires a sum of some offsets 1) offset of the local placements of the building story and the building element + 2) offset of the base level of the building element to its local placement) and coordinate transformations.</i> | The information itself (reference to storey, relative placement to storey and placement of column extrusion body within the object placement) is part of the coordination view. It has however not be verified nor enforced to be interpreted as vertical base offset.                                     |  | Add an implematation guide on how to re-generate the offset exported as part of the local placement and geometric representation.  |  |
| 5      | <b>BRACE</b>    |          |                              | Brace is not an individual entity in IFC. A brace is represented as a <i>IfcMemberType</i> with <i>PredefinedType=.BRACE</i> . If no types are exchanged, each individual occurrence shall be an <i>IfcMember</i> with <i>ObjectType='Brace'</i> .  | Labelling members as braces is currently not enforced in the coordination view.<br>It should be enforced, if such information is available in the authoring tool.  | <b>Brace diagram</b>   |  |  |
|        |                 | 1        | <b>Brace Axis</b>            | Additional <i>IfcShapeRepresentation</i> with <i>RepresentationType = Axis</i> . The <i>IfcGeometricRepresentationItem</i> is a single <i>IfcPolyline</i> (or <i>IfcTrimmedCurve</i> with <i>BaseCurve IfcLine</i> , or <i>IfcCircle</i> )  | Currently not enforced in the coordination view.   | "Axis Definition"  |  |  |
|        |                 | 1        | <b>Profile Name</b>          | For all parametric profiles and all extrusion based profiles it is currently provided as a single string value - <i>IfcProfileDef.ProfileName</i> .<br><br>Need some additional agreement where a section designator (plus eventually a section table name) goes in IFC file for any type of geometry representation, e.g. in case of BREP or <i>SurfaceModels</i> .  | The entity <i>IfcProfileDef</i> (it's subtypes) is already required as part of the Coordination view and certification. Filling the attribute <i>ProfileName</i> (with sensible values) is however not yet enforced.<br><br>It should be enforced, if such information is available in the authoring tool. | "Profile Definition" - see also "Single Value Property Definition" | use the "Profile Definition" agreement for all <i>SweptSolid</i> 's. Agree to use AISC naming convention as far as applicable. Add to implementation scope as an enforcement of the coordination view. | add a general place to find a profile name and section table name independently of the profile geometry. For now profile names should be passed as a property set, as it cannot be added to a <i>brep brace</i> . Better support to be added in IFC2x4 |
|        |                 | 1        | <b>Material Name</b>         | <i>IfcMaterial.Name</i> - it is currently the only string value applicable for material name. There is no distinction between a material name as general name and material category (steel, column, timber, etc.)   | Support of <i>IfcMaterial.Name</i> is part of the coordination view and enforced. A separate field for the material category is not yet provided.  | VBL-345<br>VBL-265   | Support of material name added to implementation scope as an enforcement of the coordination view.   | Add a second attribute in IFC2x4 to differentiate a user name for any material and the material category.  |
|        |                 | 1        | <b>Grade</b>                 | Currently there is no specific attribute for grade, it should be handled by material classification (grade name "36" and referenced standard "ASTM". It would be represented by <i>IfcMaterial.(INV)ClassifiedAs</i> and <i>IfcClassificationReference</i> .  | Not part of the coordination view. Can be added for this testbed.  | "Material Grade"   | Support of material classification added to implementation scope.  |  |

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|        |                 | 1        | <b>Length</b>                | Lenght is perceived in IFC as a quantity, i.e. it is a measurement taken from the geometry that should be exchanged in addition to the geometric representation. Such quantities should be added for downstream applications (not having an own geometric kernel). In this use case it could be expected from the receiving application to reestablish:<br>- (physical) length from the extrusion length<br>- logical length from the length of the axis representation<br>Simple Quantity (using <i>IfcQuantityLength</i> with the Name 'Length'), optionally a "LogicalLength" can be supported in addition. | export of quantities are part of the "QTO view", which is an add on to the coordination view (and not a part).<br>export of an additional axis representation of the column is currently optional in the coordination view.   | "Single Quantity" also see QTO implementation guide. | Export of quantities is in scope of the QTO addon view. It should be added to implementation scope.   |   |
|        |                 | 1        | <b>Roll</b>                  | Roll is a redundant information given in addition to the geometric representation, but helpful for analysing the model, it should be provided as a property, similar to the Span property in Pset_ColumnCommon   | Currently not part of the Pset_ColumnCommon, should be added as a new property. Can be added for this testbed.  | "Single Value Property Definition"                   | Single Value Property Definition (principle of property definition that is needed here, property name would be 'Roll' with an value of the type <i>IfcPlaneAngleMeasure</i> ; <i>IfcPropertySet.Name</i> = 'Pset_ColumnCommon') | add Roll to Pset_ColumnCommon for IFC2x4                                    |
|        |                 | 1        | <b>Cardinal point</b>        |  | The cardinal point is currently not supported in IFC2x3, ist support is already proposed for IFC2x4.  | - not in 2x3 -                                       | not included, new schema IFC2x4 is required to support it.  | add CardinalPoint to IFC2x4 as part of the new material-profile definition. |
|        |                 | 1        | <b>Element ID</b>            | the element-id is not identical to the GUID, it is a unique number, given by the exporting software system, like a handle. The IFC representation is <i>IfcBeam.Tag</i> - see ist definition:<br><i>Tag : The tag (or label) identifier at the particular instance of a product, e.g. the serial number, or the position number. It is the identifier at the occurrence level.</i>   | Currently supported in an ambiguous way, e.g. as part of the <i>IfcMember.Name</i> - need to be unified.  |  | Provide an unambiguous way to export the element ID, recommended is <i>IfcMember.Tag</i> .  |   |
|        |                 | 2        | <b>Schedule Mark</b>         |  | Currently not supported in an unambiguous way.  |  | Provide an unambiguous way to export the schedule mark by using <i>Pset_MemberCommon.Reference</i>  |   |
|        |                 | 2        | <b>Base Reference Story</b>  | Is used for the containment information, i.e. the assignment of building elements (column, beam, wall, slab, ...) to spatial structure elements (typically the building story).  | Supported by the coordination view. It might not show up in the GUI of the receiving application - in this case implementation has to be improved.  | "Spatial Container"                                  | Include and verify it.  |   |
|        |                 | 2        | <b>Top Reference Story</b>   | May evaluate the containment information and the spatial structure. Requires to follow some references and may to check the geometry (length and offset of the column, reference high of the building storeys).  | Not currently supported in the coordination view, the IFC relationship, <i>IfcRelReferencedInSpatialStructure</i> would support it, but would need to be added to the coordination view.  | "Referenced in Spatial Structure"                    | Propose an addition to the view definition with an implementation guideline for capturing the top reference storey.   |   |
|        |                 | 2        | <b>Vertical Start Offset</b> | <i>The offset can be calculated from the element geometry. Please note that building elements (column, beam, wall, slab) are typically placed relative to their spatial container (see Base Reference.Story) so that offset calculation is often very simple. However, the most general case might requires a sum of some offsets 1) offset of the local placements of the building story and the building element + 2) offset of the base level of the building element to its local placement) and coordinate transformations.</i>   | The information itself (reference to storey, relative placement to storey and placement of brace extrusion body within the object placement) is part of the coordination view. It has however not be verified nor enforced to be interpreted as vertical base offset. |  |   |   |

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|        |                 | 2        | Vertical End Offset | <i>The offset can be calculated from the element geometry. Please note that building elements (column, beam, wall, slab) are typically placed relative to their spatial container (see Base Reference.Story) so that offset calculation is often very simple. However, the most general case might require a sum of some offsets 1) offset of the local placements of the building story and the building element + 2) offset of the base level of the building element to its local placement) and coordinate transformations.</i>   | The information itself (reference to storey, relative placement to storey and placement of brace extrusion body within the object placement) is part of the coordination view. It has however not been verified nor enforced to be interpreted as vertical base offset. |  |  |   |
| 6      | WALL            |          |                     |   |   | Wall diagram   |  |   |
|        |                 | 1        | Thickness           | The thickness of a wall can be stored in two ways:<br>1) as element quantity - <i>NominalWidth</i> (see also IAI definition of <i>IfcWall</i> )<br>2) For standard walls (definable with vertical extrusion and single/constant thickness) the thickness can be deduced from the material definition. It is agreed that the material of standard walls is defined by <i>IfcMaterialLayerSetUsage</i> and <i>IfcMaterialLayerSet</i> , which define the Alignment and the total Thickness of the wall.<br>Please note that <i>IfcMaterialLayerSet.TotalThickness</i> is a derived attribute and thus not stored in an IFC file (it is defined as sum of all layer thicknesses). Consequently, reading IFC files means to calculate the total thickness from the wall layers<br>> <i>TotalThickness</i> =<br><i>IfcMaterialLayerSet.MaterialLayers[1].LayerThickness</i> +<br><i>IfcMaterialLayerSet.MaterialLayers[2].LayerThickness</i> +<br><i>IfcMaterialLayerSet.MaterialLayers[...].LayerThickness</i> +<br><i>IfcMaterialLayerSet.MaterialLayers[n].LayerThickness</i> ; | <i>IfcWallStandardCase</i> + <i>IfcMaterialLayerSetUsage</i> is part of the coordination view.  | 1) "Single Quantity" (NominalWidth)<br><br>or<br><br>2) "Material Layer Definition" (sum of all layer thicknesses) |  |   |
|        |                 | 1        | Material Name       | Material is defined for each layer. In case of a single layer wall there is only one instance of <i>IfcMaterial</i> capturing the material name. For single layer walls the material name can be accessed as follows:<br><i>IfcWallStandardCase.(INV)HasAssociations</i> -><br><i>IfcRelAssociatesMaterial.RelatingMaterial</i> -><br><i>IfcMaterialLayerSetUsage.ForLayerSet</i> -><br><i>IfcMaterialLayerSet.MaterialLayers[1]</i> -><br><i>IfcMaterialLayer.Material</i> -> <i>IfcMaterial</i>   | Support of <i>IfcMaterial.Name</i> is part of the coordination view and enforced. A separate field for the material category is not yet provided.   | VBL-345<br>VBL-265   | Support of material name added to implementation scope as an enforcement of the coordination view. | Add a second attribute in IFC2x4 to differentiate a user name for any material and the material category. |
|        |                 | 1        | Grade               | Currently there is no specific attribute for grade, it should be handled by material classification (grade name "36" and referenced standard "ASTM". It would be represented by <i>IfcMaterial.(INV)ClassifiedAs</i> and <i>IfcClassificationReference</i> .  | Not part of the coordination view. Can be added for this testbed.   | "Material Grade"   | Support of material classification added to implementation scope.                                  |   |
|        |                 | 1        | Wall Axis           | Additional <i>IfcShapeRepresentation</i> with <i>RepresentationType</i> = Axis. The <i>IfcGeometricRepresentationItem</i> is a single <i>IfcPolyline</i> (or <i>IfcTrimmedCurve</i> with <i>BaseCurve IfcLine</i> , or <i>IfcCircle</i> )   |   | "Axis Definition"  |  |   |

| Number | Object Category | Priority | Attribute Name              | IFC representation of the exchange   | Status of IFC implementation, model view definition, certification process   | MVD name  | Recommendations for ATC-75 implementation   | Recommendation for further IFC development |
|--------|-----------------|----------|-----------------------------|--|--|---|---|--|
|        |                 | 1        | <b>Alignment</b>            | The wall body is defined by <i>IfcShapeRepresentation</i> with <i>RepresentationType</i> = Body. The <i>IfcGeometricRepresentationItem</i> is a swept solid representation or a CSG. Both representation types, the wall axis and the body representation, use the same coordinate system ( <i>IfcWall.ObjectPlacement</i> ) enabling to deduce the alignment of the wall body relative to the wall axis. Alternatively, the alignment can be read (without geometric calculations) from the material layer settings ( <i>IfcMaterialLayerSetUsage.OffsetFromReferenceLine</i> ). The reference line is the wall axis. The offset is given for the selected axis ( <i>IfcMaterialLayerSetUsage.LayerSetDirection</i> ) and direction ( <i>IfcMaterialLayerSetUsage.DirectionSense</i> ). |  | "Material Layer Definition" (OffsetFromReferenceLine) |   |  |
|        |                 | 2        | <b>Base Reference Story</b> | Is used for the containment information, i.e. the assignment of building elements (column, beam, wall, slab, ...) to spatial structure elements (typically the building story).  | Supported by the coordination view. It might not show up in the GUI of the receiving application - in this case implementation has to be improved.   | "Spatial Container"                                   | Include and verify it.  |  |
|        |                 | 2        | <b>Top Reference Story</b>  | May evaluate the containment information and the spatial structure. Requires to follow some references and may to check the geometry (length and offset of the wall, reference high of the building storeys).  | Not currently supported in the coordination view, the IFC relationship, <i>IfcRelReferencedInSpatialStructure</i> would support it, but would need to be added to the coordination view.   | "Referenced in Spatial Structure"                     | Propose an addition to the view definition with an implementation guideline for capturing the top reference storey. |  |
|        |                 | 2        | <b>Base Offset</b>          | The offset can be calculated from the element geometry. Please note that building elements (column, beam, wall, slab) are typically placed relative to their spatial container (see Base Reference.Story) so that offset calculation is often very simple. However, the most general case might requires a sum of some offsets (1) offset of the base reference to the local placement of the building story + 2) offset of the local placements of the building story and the building element + 3) offset of the base level of the building element to its local placement) and coordinate transformations.  | The information itself (reference to storey, relative placement to storey and placement of column extrusion body within the object placement) is part of the coordination view. It has however not be verified nor enforced to be interpreted as vertical base offset. |   |   |  |
|        |                 | 2        | <b>Top Offset</b>           | see Base Offset and Top Reference.Story  | <i>depends on the clarification of the above requirements</i>  |   |   |  |
|        |                 | 2        | <b>Load bearing</b>         | Stored in the property set <i>Pset_WallCommon</i> , with the name <i>LoadBearing</i> = TRUE or FALSE.  |  | "Single Value Property Definition"                    |   |  |
| 7      | SLAB            |          |                             |  |  | Slab diagram  |   |  |

| Number | Object Category | Priority | Attribute Name              | IFC representation of the exchange   | Status of IFC implementation, model view definition, certification process   | MVD name   | Recommendations for ATC-75 implementation      | Recommendation for further IFC development                  |
|--------|-----------------|----------|-----------------------------|--|--|--|--|---|
|        |                 | 1        | <b>Thickness</b>            | The thickness of a slab can be stored in two ways:<br>1) as element quantity - <i>NominalWidth</i> (see IAI definition of <i>IfcSlab</i> )<br>2) For standard slabs (constant thickness along the extrusion direction) the thickness can be deduced from the material definition. It is agreed that the material of standard slabs is defined by <i>IfcMaterialLayerSetUsage</i> and <i>IfcMaterialLayerSet</i> , which define the Alignment and the total Thickness of the slab. Please note that <i>IfcMaterialLayerSet.TotalThickness</i> is a derived attribute and thus not stored in an IFC file (it is defined as sum of all layer thicknesses). Consequently, reading IFC files means to calculate the total thickness from the slab layers -> <i>TotalThickness</i> =<br><i>IfcMaterialLayerSet.MaterialLayers[1].LayerThickness</i> +<br><i>IfcMaterialLayerSet.MaterialLayers[2].LayerThickness</i> +<br><i>IfcMaterialLayerSet.MaterialLayers[...].LayerThickness</i> +<br><i>IfcMaterialLayerSet.MaterialLayers[n].LayerThickness</i> ; | Included in the coordination view for the correct setting of material layer definitions. Use of single quantity is part of the quantity take-off add-on view.  | 1) "Single Quantity" (NominalWidth)<br><br>or<br>2) "Material Layer Definition" (sum of all layer thicknesses) | Include and verify it.                         |   |
|        |                 | 1        | <b>Material Name</b>        | Material is defined for each layer. Single layer slabs have only one instance of <i>IfcMaterial</i> and thus only one material name. The material name can be accessed as follows:<br><i>IfcWallStandardCase.(INV)HasAssociations</i> -><br><i>IfcRelAssociatesMaterial.RelatingMaterial</i> -><br><i>IfcMaterialLayerSetUsage.ForLayerSet</i> -><br><i>IfcMaterialLayerSet.MaterialLayers[1]</i> -><br><i>IfcMaterialLayer.Material</i> -> <i>IfcMaterial</i>   |  | VBL-345<br>VBL-265   | Include and verify it.                         |   |
|        |                 | 1        | <b>Grade</b>                | Currently there is no specific attribute for grade, it should be handled by material classification (grade name "36" and referenced standard "ASTM". It would be represented by <i>IfcMaterial.(INV)ClassifiedAs</i> and <i>IfcClassificationReference</i> .   |  | "Material Grade"   |  |   |
|        |                 | 2        | <b>Base Reference Story</b> | Is used for the containment information, i.e. the assignment of building elements (column, beam, wall, slab, ...) to spatial structure elements (typically the building story).  | Supported by the coordination view. It might not show up in the GUI of the receiving application - in this case implementation has to be improved.   | "Spatial Container"  | Include and verify it.                         |   |
|        |                 | 2        | <b>Base Offset</b>          | The offset can be calculated from the element geometry. Please note that building elements (column, beam, wall, slab) are typically placed relative to their spatial container (see Base Reference.Story) so that offset calculation is often very simple. However, the most general case might require a sum of some offsets (1) offset of the base reference to the local placement of the building story + 2) offset of the local placements of the building story and the building element + 3) offset of the base level of the building element to its local placement) and coordinate transformations.   | The information itself (reference to storey, relative placement to storey and placement of column extrusion body within the object placement) is part of the coordination view. It has however not been verified nor enforced to be interpreted as vertical base offset. |  |  |   |
|        |                 | 2        | <b>Span direction</b>       | Currently there is no attribute for storing the span direction(s).   |  |  | do not include - requires IFC schema additions | recommend the addition of a span direction attribute to IFC |
| 8      | FOOTING         |          |                             |  |  | Footing diagram  |  |   |

| Number   | Object Category | Priority | Attribute Name             | IFC representation of the exchange   | Status of IFC implementation, model view definition, certification process   | MVD name            | Recommendations for ATC-75 implementation                                     | Recommendation for further IFC development |
|----------|-----------------|----------|----------------------------|--|--|---------------------|---|--|
|          |                 | 1        | <b>Footing Type</b>        | Defined by <i>IfcFooting.PredefinedType</i> ;<br>following types are available:<br>- FOOTING_BEAM<br>- PAD_FOOTING<br>- PILE_CAP<br>- STRIP_FOOTING<br>- USERDEFINED<br>- NOTDEFINED   | Included in the coordination view, but correct setting of the pile enumeration not enforced.   |                     | Check the current setting of the pile type in IFC exchanges for benchmarking. |  |
|          |                 | 1        | <b>Material Name</b>       | <i>IfcMaterial.Name</i> - it is currently the only string value applicable for material name. There is no distinction between a material name as general name and material category (steel, column, timber, etc.)  |  | VBL-345<br>VBL-265  | Include and verify it.  |  |
|          |                 | 1        | <b>Grade</b>               | Currently there is no specific attribute for grade, it should be handled by material classification (grade name "36" and referenced standard "ASTM". It would be represented by <i>IfcMaterial.(INV)ClassifiedAs</i> and <i>IfcClassificationReference</i> .                 |  | "Material Grade"    |   |  |
|          |                 | 2        | <b>Top Reference Story</b> | Is used for the containment information, i.e. the assignment of building elements (column, beam, wall, slab, ...) to spatial structure elements (typically the building story).<br><i>Note: it is the reference storey (the term "top" is not preserved in the exchange)</i> | Supported by the coordination view. It might not show up in the GUI of the receiving application - in this case implementation has to be improved. | "Spatial Container" | Include and verify it.  |  |
|          |                 | 2        | <b>Bottom Elevation</b>    | Equal to the extrusion length parameter of the footing   |  |                     |   |  |
| <b>9</b> | <b>PILE</b>     |          |                            |  |  | Pile diagram        |   |  |
|          |                 | 1        | <b>Pile Type</b>           | Defined by <i>IfcPile.PredefinedType</i> ;<br>following types are available:<br>- COHESION<br>- FRICTION<br>- SUPPORT<br>- USERDEFINED<br>- NOTDEFINED   | Included in the coordination view, but correct setting of the pile enumeration not enforced.   |                     | Check the current setting of the pile type in IFC exchanges for benchmarking. |  |
|          |                 | 1        | <b>Material Name</b>       | <i>IfcMaterial.Name</i> - it is currently the only string value applicable for material name. There is no distinction between a material name as general name and material category (steel, column, timber, etc.)  |  | VBL-345<br>VBL-265  | Include and verify it.  |  |
|          |                 | 1        | <b>Grade</b>               | Currently there is no specific attribute for grade, it should be handled by material classification (grade name "36" and referenced standard "ASTM". It would be represented by <i>IfcMaterial.(INV)ClassifiedAs</i> and <i>IfcClassificationReference</i> .                 |  | "Material Grade"    |   |  |
|          |                 | 2        | <b>Top Reference Story</b> | Is used for the containment information, i.e. the assignment of building elements (column, beam, wall, slab, ...) to spatial structure elements (typically the building story).<br><i>Note: it is the reference storey (the term "top" is not preserved in the exchange)</i> | Supported by the coordination view. It might not show up in the GUI of the receiving application - in this case implementation has to be improved. | "Spatial Container" | Include and verify it.  |  |
|          |                 | 2        | <b>Bottom Elevation</b>    |  |  |                     |   |  |