Industry Foundation Classes - Release 2.0

Specifications Volume 3

IFC Object Model Reference

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International Alliance for Interoperability

Enabling Interoperability in the AEC/FM Industry

Industry Foundation Classes - Release 2.0

Specifications Volume 3

IFC Object Model Reference

Enabling Interoperability in the AEC/FM Industry

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Content Overview

1. Introduction, Scope and Assumptions **1**

Resources Model Layer

2. IfcActorResource **7**
3. IfcClassificationResource **12**
4. IfcCostResource **15**
5. IfcDateTimeResource **18**
6. IfcDocumentResource **25**
7. IfcGeometryResource **27**
8. IfcMaterialResource **94**
9. IfcMeasureResource **99**
10. IfcPropertyResource **124**
11. IfcRepresentationResource **130**
12. IfcUtilityResource **139**

Core Model Layer

13. IfcKernel **147**
14. IfcControlExtension **173**
15. IfcModelingAidExtension **187**
16. IfcProcessExtension **199**
17. IfcProductExtension **211**
18. IfcProjectMgmtExtension **248**

Interoperability Model Layer

19. IfcSharedBldgElements **261**
20. IfcSharedBldgServiceElements **314**
21. IfcSharedSpatialElements **385**

Domain/Applications Model Layer

22. IfcArchitectureDomain **395**
23. IfcConstructionMgmtDomain **434**
24. IfcFacilitiesMgmtDomain **442**
25. IfcHvacDomain **461**

Content Detail

1. Introduction, Scope and Assumptions **1**
1.1. Purpose of these documents 1
1.2. IFC Release Document Suite 1
1.3. Scope 2
1.4. Assumptions and Abbreviations 5
1.5. International Alliance for Interoperability (IAI) 6

Resources Model Layer

2. IfcActorResource **7**
2.1. Select IfcActorSelect 7
2.2. Type IfcRoleEnum 7
2.3. Class IfcActorRole 8
2.4. Class IfcAddress 8
2.5. Class IfcOrganization 10
2.6. Class IfcPerson 10

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2.7. Class IfcPersonAndOrganization ... 11
3. IfcClassificationResource ... 12
3.1. Class IfcClassification ... 12
3.2. Class IfcClassificationList ... 13
3.3. Class IfcClassificationNotation ... 14
3.4. Class IfcNotationFacet ... 14
4. IfcCostResource ... 15
4.1. Type IfcCostEnum ... 15
4.2. Type IfcCostOperatorEnum ... 15
4.3. Type IfcModifierBasisEnum ... 16
4.4. Class IfcCost ... 16
4.5. Class IfcCostModifier ... 18
5. IfcDateTimeResource ... 18
5.1. Type IfcDayInMonthNumber ... 19
5.2. Type IfcDaylightSavingNumber ... 19
5.3. Type IfcHourInDay ... 19
5.4. Type IfcMinuteInHour ... 20
5.5. Type IfcMonthInYearNumber ... 20
5.6. Type IfcSecondInMinute ... 20
5.7. Type IfcYearNumber ... 21
5.8. Select IfcDateTimeSelect ... 21
5.9. Type IfcAheadOrBehind ... 21
5.10. Class IfcCalendarDate ... 22
5.11. Class IfcCoordinatedUniversalTimeOffset ... 22
5.12. Class IfcDateAndTime ... 23
5.13. Class IfcLocalTime ... 23
5.14. Function IfcLeapYear ... 24
5.15. Function IfcValidCalendarDate ... 24
5.16. Function IfcValidTime ... 24
6. IfcDocumentResource ... 25
6.1. Class IfcDocumentReference ... 25
6.2. Class IfcDocumentType ... 26
7. IfcGeometryResource ... 27
7.1. Type IfcDimensionCount ... 27
7.2. Select IfcAxis2Placement ... 28
7.3. Select IfcBooleanOperand ... 28
7.4. Select IfcCsgSelect ... 28
7.5. Select IfcTrimmingSelect ... 29
7.6. Select IfcVectorOrDirection ... 29
7.7. Type IfcBooleanOperator ... 29
7.8. Type IfcProfileTypeEnum ... 30
7.9. Type IfcTransitionCode ... 30
7.10. Type IfcTrimmingPreference ... 31
7.11. Class Ifc2DCompositeCurve ... 31
7.12. Class IfcArbitraryProfileDef ... 32
7.13. Class IfcAttDrivenClippedExtrudedSolid ... 33
7.14. Class IfcAttDrivenClippedRevolvedSolid ... 34
7.15. Class IfcAttDrivenExtrudedSegment ... 36
7.16. Class IfcAttDrivenExtrudedSolid ... 37
7.17. Class IfcAttDrivenMorphedExtrudedSegment ... 39
7.18. Class IfcAttDrivenMorphedRevolvedSegment ... 41
7.19. Class IfcAttDrivenProfileDef ... 42
7.20. Class IfcAttDrivenRevolvedSegment ... 43
7.21. Class IfcAttDrivenRevolvedSolid ... 45
7.22. Class IfcAttDrivenTaperedExtrudedSegment ... 47
7.23. Class IfcAttDrivenTaperedRevolvedSegment ... 48
7.24. Class IfcAxis1Placement ... 49

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7.25. Class IfcAxis2Placement2D ... 50
7.26. Class IfcAxis2Placement3D ... 51
7.27. Class IfcBooleanResult ... 52
7.28. Class IfcBoundedCurve ... 53
7.29. Class IfcBoundingBox ... 54
7.30. Class IfcBoxedHalfSpace ... 55
7.31. Class IfcCartesianPoint ... 56
7.32. Class IfcCircle ... 56
7.33. Class IfcCircleProfileDef ... 57
7.34. Class IfcClosedShell ... 58
7.35. Class IfcCompositeCurve ... 59
7.36. Class IfcCompositeCurveSegment ... 60
7.37. Class IfcConic ... 61
7.38. Class IfcConnectedFaceSet ... 62
7.39. Class IfcCsgSolid ... 62
7.40. Class IfcCurve ... 63
7.41. Class IfcCurveBoundedPlane ... 64
7.42. Class IfcDirection ... 65
7.43. Class IfcEdge ... 66
7.44. Class IfcElementarySurface ... 67
7.45. Class IfcEllipse ... 67
7.46. Class IfcExtrudedAreaSolid ... 68
7.47. Class IfcFace ... 69
7.48. Class IfcFaceBound ... 70
7.49. Class IfcFaceOuterBound ... 71
7.50. Class IfcFacetedBrep ... 71
7.51. Class IfcFacetedBrepWithVoids ... 72
7.52. Class IfcGeometricRepresentationItem ... 73
7.53. Class IfcHalfSpaceSolid ... 74
7.54. Class IfcLine ... 75
7.55. Class IfcManifoldSolidBrep ... 75
7.56. Class IfcOrientedEdge ... 76
7.57. Class IfcPath ... 77
7.58. Class IfcPlacement ... 78
7.59. Class IfcPlane ... 79
7.60. Class IfcPoint ... 80
7.61. Class IfcPolyLoop ... 80
7.62. Class IfcPolyline ... 81
7.63. Class IfcRectangleProfileDef ... 82
7.64. Class IfcRevolvedAreaSolid ... 83
7.65. Class IfcSolidModel ... 83
7.66. Class IfcSurface ... 84
7.67. Class IfcSweptAreaSolid ... 85
7.68. Class IfcTopologicalRepresentationItem ... 86
7.69. Class IfcTrapeziumProfileDef ... 86
7.70. Class IfcTrimmedCurve ... 87
7.71. Class IfcVector ... 89
7.72. Class IfcVertex ... 90
7.73. Function IfcBooleanChoose ... 90
7.74. Function IfcBuild2Axes ... 91
7.75. Function IfcBuildAxes ... 91
7.76. Function IfcCircleProfileIntoCurve ... 91
7.77. Function IfcCrossProduct ... 91
7.78. Function IfcCurveDim ... 92
7.79. Function IfcDotProduct ... 92
7.80. Function IfcExtrusionPath ... 92
7.81. Function IfcFirstProjAxis ... 92
7.82. Function IfcNormalise ... 92

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7.83. Function IfcOrthogonalComplement ... 93
7.84. Function IfcPathHeadToTail ... 93
7.85. Function IfcPointTranslation ... 93
7.86. Function IfcProfileIntoArea ... 93
7.87. Function IfcRectangleProfileIntoCurve ... 93
7.88. Function IfcRevolutionPath ... 93
7.89. Function IfcScalarTimesVector ... 94
7.90. Function IfcTrapeziumProfileIntoCurve ... 94
7.91. Function IfcVectorDifference ... 94

8. IfcMaterialResource ... 94
8.1. Select IfcMaterialPropertySelect ... 94
8.2. Select IfcMaterialSelect ... 95
8.3. Class IfcMaterial ... 95
8.4. Class IfcMaterialFinish ... 96
8.5. Class IfcMaterialLayer ... 97
8.6. Class IfcMaterialLayerSet ... 97
8.7. Class IfcMaterialLayerSetUsage ... 98
8.8. Class IfcMaterialList ... 99
8.9. Function IfcMlsTotalThickness ... 99

9. IfcMeasureResource ... 99
9.1. Type IfcAmountOfSubstanceMeasure ... 100
9.2. Type IfcAngularVelocityMeasure ... 100
9.3. Type IfcAreaMeasure ... 100
9.4. Type IfcBoolean ... 100
9.5. Type IfcCompoundPlaneAngleMeasure ... 101
9.6. Type IfcContextDependentMeasure ... 101
9.7. Type IfcCountMeasure ... 101
9.8. Type IfcDescriptiveMeasure ... 101
9.9. Type IfcDynamicViscosityMeasure ... 102
9.10. Type IfcElectricCurrentMeasure ... 102
9.11. Type IfcElectricVoltageMeasure ... 102
9.12. Type IfcEnergyMeasure ... 103
9.13. Type IfcFrequencyMeasure ... 103
9.14. Type IfcHeatFluxDensityMeasure ... 103
9.15. Type IfcInteger ... 104
9.16. Type IfcIntegerCountRateMeasure ... 104
9.17. Type IfcKinematicViscosityMeasure ... 104
9.18. Type IfcLengthMeasure ... 105
9.19. Type IfcLinearVelocityMeasure ... 105
9.20. Type IfcLuminousIntensityMeasure ... 105
9.21. Type IfcMassDensityMeasure ... 105
9.22. Type IfcMassFlowRateMeasure ... 106
9.23. Type IfcMassMeasure ... 106
9.24. Type IfcMonetaryMeasure ... 106
9.25. Type IfcNumericMeasure ... 107
9.26. Type IfcParameterValue ... 107
9.27. Type IfcPlaneAngleMeasure ... 107
9.28. Type IfcPositiveLengthMeasure ... 107
9.29. Type IfcPositivePlaneAngleMeasure ... 108
9.30. Type IfcPositiveRatioMeasure ... 108
9.31. Type IfcPowerMeasure ... 108
9.32. Type IfcPressureMeasure ... 108
9.33. Type IfcRatioMeasure ... 109
9.34. Type IfcReal ... 109
9.35. Type IfcSolidAngleMeasure ... 109
9.36. Type IfcString ... 110
9.37. Type IfcThermalAdmittanceMeasure ... 110
9.38. Type IfcThermalResistanceMeasure ... 110

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9.39. Type IfcThermalTransmittanceMeasure ... 110
9.40. Type IfcThermodynamicTemperatureMeasure ... 111
9.41. Type IfcTimeMeasure ... 111
9.42. Type IfcTimeStamp ... 111
9.43. Type IfcVolumeMeasure ... 111
9.44. Type IfcVolumetricFlowrateMeasure ... 112
9.45. Select IfcMeasureValue ... 112
9.46. Select IfcUnit ... 113
9.47. Type IfcCurrencyEnum ... 113
9.48. Type IfcDerivedUnitEnum ... 115
9.49. Type IfcSiPrefix ... 116
9.50. Type IfcSiUnitName ... 117
9.51. Type IfcUnitEnum ... 117
9.52. Class IfcContextDependentUnit ... 118
9.53. Class IfcConversionBasedUnit ... 118
9.54. Class IfcDerivedUnit ... 119
9.55. Class IfcDerivedUnitElement ... 120
9.56. Class IfcDimensionalExponents ... 120
9.57. Class IfcMeasureWithUnit ... 121
9.58. Class IfcNamedUnit ... 122
9.59. Class IfcSiUnit ... 122
9.60. Class IfcUnitAssignment ... 123
9.61. Function IfcCorrectDimensions ... 123
9.62. Function IfcDeriveDimensionalExponents ... 124
9.63. Function IfcDimensionsForSiUnit ... 124

10. IfcPropertyResource ... 124
10.1. Select IfcObjectReferenceSelect ... 124
10.2. Class IfcEnumeratedProperty ... 125
10.3. Class IfcEnumeration ... 125
10.4. Class IfcLibrary ... 126
10.5. Class IfcLibraryReference ... 127
10.6. Class IfcObjectReference ... 127
10.7. Class IfcProperty ... 128
10.8. Class IfcPropertyList ... 129
10.9. Class IfcSimpleProperty ... 129
10.10. Class IfcSimplePropertyWithUnit ... 130

11. IfcRepresentationResource ... 130
11.1. Class IfcGeometricRepresentationContext ... 131
11.2. Class IfcProductDefinitionShape ... 132
11.3. Class IfcProductDefinitionTopology ... 133
11.4. Class IfcProductRepresentation ... 133
11.5. Class IfcRepresentation ... 134
11.6. Class IfcRepresentationContext ... 135
11.7. Class IfcShapeAspect ... 136
11.8. Class IfcShapeRepresentation ... 137
11.9. Class IfcTopologyRepresentation ... 138

12. IfcUtilityResource ... 139
12.1. Type IfcGloballyUniqueId ... 139
12.2. Type IfcModifiedFlag ... 140
12.3. Class IfcApplication ... 140
12.4. Class IfcAuditTrail ... 141
12.5. Class IfcOwnerHistory ... 142
12.6. Class IfcTable ... 143
12.7. Class IfcTableRow ... 145
12.8. Class IfcTransaction ... 146

Core Model Layer

13. IfcKernel ... 147

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13.1. Select IfcObjectWithPlacementSelect ... 147
13.2. Type IfcContainedOrReferencedEnum ... 147
13.3. Type IfcContainmentEnum ... 148
13.4. Type IfcProxyEnum ... 148
13.5. Type IfcResourceConsumptionEnum ... 149
13.6. Type IfcSequenceEnum ... 149
13.7. Class IfcActor ... 149
13.8. Class IfcControl ... 150
13.9. Class IfcExtensionPropertySet ... 151
13.10. Class IfcGroup ... 152
13.11. Class IfcLocalPlacement ... 153
13.12. Class IfcModelingAid ... 154
13.13. Class IfcObject ... 154
13.14. Class IfcProcess ... 156
13.15. Class IfcProduct ... 157
13.16. Class IfcProject ... 158
13.17. Class IfcPropertyDefinition ... 159
13.18. Class IfcPropertySet ... 160
13.19. Class IfcProxy ... 161
13.20. Class IfcRelActsUpon ... 162
13.21. Class IfcRelAssignsProperties ... 162
13.22. Class IfcRelAssignsTypedProperties ... 163
13.23. Class IfcRelContains ... 164
13.24. Class IfcRelControls ... 165
13.25. Class IfcRelGroups ... 166
13.26. Class IfcRelNests ... 167
13.27. Class IfcRelProcessOperatesOn ... 168
13.28. Class IfcRelSequence ... 169
13.29. Class IfcRelationship ... 170
13.30. Class IfcResource ... 171
13.31. Class IfcRoot ... 172

14. IfcControlExtension ... 173
14.1. Select IfcMetricValueSelect ... 173
14.2. Type IfcAggregatorEnum ... 173
14.3. Type IfcApprovalStatusEnum ... 174
14.4. Type IfcBenchmarkEnum ... 174
14.5. Type IfcConstraintEnum ... 175
14.6. Type IfcConstraintRelationshipEnum ... 175
14.7. Type IfcElementConditionEnum ... 175
14.8. Type IfcMaintenanceTypeEnum ... 176
14.9. Type IfcMetricDataEnum ... 176
14.10. Type IfcObjectiveEnum ... 177
14.11. Class IfcApproval ... 177
14.12. Class IfcConstraint ... 178
14.13. Class IfcMaintenanceRecord ... 179
14.14. Class IfcMaintenanceType ... 180
14.15. Class IfcMetric ... 181
14.16. Class IfcMetricBenchmark ... 182
14.17. Class IfcMetricValue ... 182
14.18. Class IfcObjective ... 183
14.19. Class IfcRelAggregatesConstraints ... 184
14.20. Class IfcRelAssignsApprovals ... 185
14.21. Class IfcRelControlsMaintenance ... 185
14.22. Class IfcRelRelatesConstraints ... 186

15. IfcModelingAidExtension ... 187
15.1. Select IfcReferenceCurveSelect ... 187
15.2. Select IfcReferencePointSelect ... 187
15.3. Class IfcConstrainedPlacement ... 188

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15.4. Class IfcConstraintRelIntersection ... 188
15.5. Class IfcDesignGrid ... 189
15.6. Class IfcGridAxis ... 190
15.7. Class IfcGridIntersection ... 192
15.8. Class IfcGridLevel ... 193
15.9. Class IfcLightSource ... 194
15.10. Class IfcPhotometricOutputSpace ... 195
15.11. Class IfcPlacementConstraint ... 196
15.12. Class IfcReferenceCurve ... 196
15.13. Class IfcReferenceGeometryAid ... 197
15.14. Class IfcReferencePoint ... 198
15.15. Class IfcReferenceSurface ... 198

16. IfcProcessExtension ... 199
16.1. Type IfcMultiplierOrDivider ... 199
16.2. Type IfcWorkPlanPurposeEnum ... 200
16.3. Type IfcWorkTaskMilestoneEnum ... 200
16.4. Type IfcWorkTaskStatusEnum ... 200
16.5. Class IfcRelNestsProcesses ... 201
16.6. Class IfcRelNestsWorkScheduleElements ... 201
16.7. Class IfcRelNestsWorkSchedules ... 202
16.8. Class IfcRelUsesResource ... 203
16.9. Class IfcScheduleTimeControl ... 204
16.10. Class IfcWorkPlan ... 206
16.11. Class IfcWorkSchedule ... 207
16.12. Class IfcWorkScheduleElement ... 208
16.13. Class IfcWorkTask ... 209

17. IfcProductExtension ... 211
17.1. Type IfcConnectionEnum ... 211
17.2. Type IfcElectricCurrentEnum ... 211
17.3. Type IfcInternalOrExternalEnum ... 212
17.4. Type IfcPhysicalOrVirtualEnum ... 212
17.5. Class IfcBuilding ... 212
17.6. Class IfcBuildingElement ... 215
17.7. Class IfcBuildingStorey ... 216
17.8. Class IfcConnectionGeometry ... 218
17.9. Class IfcElectricalCharacteristics ... 219
17.10. Class IfcElement ... 220
17.11. Class IfcLineConnectionGeometry ... 221
17.12. Class IfcManufactureInformation ... 222
17.13. Class IfcOpeningElement ... 223
17.14. Class IfcPointConnectionGeometry ... 225
17.15. Class IfcRelAssemblesElements ... 226
17.16. Class IfcRelAssemblesSpaces ... 227
17.17. Class IfcRelConnectsElements ... 228
17.18. Class IfcRelConnectsPathElements ... 229
17.19. Class IfcRelFillsElement ... 230
17.20. Class IfcRelSeparatesSpaces ... 230
17.21. Class IfcRelServicesBuildings ... 231
17.22. Class IfcRelVoidsElement ... 232
17.23. Class IfcSite ... 232
17.24. Class IfcSpace ... 234
17.25. Class IfcSpaceBoundary ... 238
17.26. Class IfcSpatialElement ... 240
17.27. Class IfcSystem ... 241
17.28. Class IfcZone ... 242
17.29. Function IfcNoOfLayers ... 242
17.30. PropertySet Pset_Asset ... 243
17.31. PropertySet Pset_BuildingCommon ... 243

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17.32. PropertySet Pset_BuildingStoreyCommon ... 243
17.33. PropertySet Pset_ElementQuantities ... 244
17.34. PropertySet Pset_ManufactureOccurrence ... 245
17.35. PropertySet Pset_OpeningElementCommon ... 246
17.36. PropertySet Pset_SiteCommon ... 246
17.37. PropertySet Pset_SpaceCommon ... 246
17.38. PropertySet Pset_SystemCommon ... 247
17.39. PropertySet Pset_ZoneCommon ... 248

18. IfcProjectMgmtExtension ... 248
18.1. Type IfcChangeOrderStatusEnum ... 248
18.2. Type IfcCostUseEnum ... 249
18.3. Type IfcPurchaseOrderStatusEnum ... 249
18.4. Type IfcWorkOrderStatusEnum ... 249
18.5. Class IfcBudget ... 250
18.6. Class IfcChangeOrder ... 251
18.7. Class IfcCostElement ... 252
18.8. Class IfcCostSchedule ... 253
18.9. Class IfcProjectOrder ... 254
18.10. Class IfcPurchaseOrder ... 255
18.11. Class IfcRelCostsObjects ... 256
18.12. Class IfcRelNestsCostElements ... 257
18.13. Class IfcRelNestsCostSchedules ... 259
18.14. Class IfcWorkOrder ... 259

Interoperability Model Layer

19. IfcSharedBldgElements ... 261
19.1. Type IfcCoveringTypeEnum ... 261
19.2. Type IfcDoorPanelTypeEnum ... 261
19.3. Type IfcJointEnum ... 262
19.4. Type IfcPermeableCoveringTypeEnum ... 262
19.5. Type IfcSlabTypeEnum ... 262
19.6. Type IfcWindowPanelOperationEnum ... 263
19.7. Type IfcWindowPanelTypeEnum ... 263
19.8. Class IfcBeam ... 264
19.9. Class IfcBuiltIn ... 266
19.10. Class IfcColumn ... 267
19.11. Class IfcCovering ... 270
19.12. Class IfcCurtainWall ... 273
19.13. Class IfcDoor ... 274
19.14. Class IfcDoorLining ... 275
19.15. Class IfcDoorPanel ... 276
19.16. Class IfcPermeableCovering ... 278
19.17. Class IfcRelAttachesToBoundaries ... 279
19.18. Class IfcRelCoversBldgElements ... 280
19.19. Class IfcRelJoinsElements ... 281
19.20. Class IfcRoof ... 281
19.21. Class IfcSlab ... 283
19.22. Class IfcWall ... 286
19.23. Class IfcWindow ... 290
19.24. Class IfcWindowLining ... 291
19.25. Class IfcWindowPanel ... 291
19.26. PropertySet Pset_BeamCommon ... 293
19.27. PropertySet Pset_BuiltInCommon ... 294
19.28. PropertySet Pset_ColumnCommon ... 294
19.29. PropertySet Pset_CoveringCeiling ... 294
19.30. PropertySet Pset_CoveringCladding ... 295
19.31. PropertySet Pset_CoveringCommon ... 295
19.32. PropertySet Pset_CoveringFlooring ... 295

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19.33. PropertySet Pset_CoveringMillwork ... 296
19.34. PropertySet Pset_DoorCommon ... 296
19.35. PropertySet Pset_DoorLiningCommon ... 298
19.36. PropertySet Pset_DoorPanelCommon ... 298
19.37. PropertySet Pset_DoorPanelRevolving ... 300
19.38. PropertySet Pset_DoorPanelRollingup ... 300
19.39. PropertySet Pset_DoorPanelSliding ... 300
19.40. PropertySet Pset_DoorPanelSwinging ... 301
19.41. PropertySet Pset_GlazingType ... 301
19.42. PropertySet Pset_HardwareGroup ... 302
19.43. PropertySet Pset_OpeningShadingType ... 303
19.44. PropertySet Pset_PermeableCoveringCommon ... 305
19.45. PropertySet Pset_PermeableCoveringGrill ... 306
19.46. PropertySet Pset_PermeableCoveringLouver ... 306
19.47. PropertySet Pset_PermeableCoveringScreen ... 307
19.48. PropertySet Pset_RoofCommon ... 307
19.49. PropertySet Pset_SlabCommon ... 307
19.50. PropertySet Pset_SlabFloor ... 308
19.51. PropertySet Pset_SlabRoof ... 308
19.52. PropertySet Pset_WallCommon ... 308
19.53. PropertySet Pset_WindowCommon ... 309
19.54. PropertySet Pset_WindowLiningCommon ... 311
19.55. PropertySet Pset_WindowPanelCommon ... 311
19.56. PropertySet Pset_WindowPanelFixed ... 313
19.57. PropertySet Pset_WindowPanelPivoting ... 313
19.58. PropertySet Pset_WindowPanelSliding ... 314
19.59. PropertySet Pset_WindowPanelSwinging ... 314

20. IfcSharedBldgServiceElements ... 314
20.1. Type IfcDiscreteElementTypeEnum ... 315
20.2. Type IfcDistributionFlowElementTypeEnum ... 315
20.3. Type IfcDistributionPortTypeEnum ... 316
20.4. Type IfcElectricalApplianceTypeEnum ... 316
20.5. Type IfcElectricalFixtureTypeEnum ... 317
20.6. Type IfcEquipmentTypeEnum ... 317
20.7. Type IfcFlowDirectionEnum ... 317
20.8. Type IfcFlowEquipmentTypeEnum ... 318
20.9. Type IfcFlowFittingTypeEnum ... 319
20.10. Type IfcFlowSegmentTypeEnum ... 319
20.11. Type IfcFlowTerminalTypeEnum ... 320
20.12. Type IfcPlumbingFixtureTypeEnum ... 320
20.13. Type IfcPrimaryFittingEnum ... 321
20.14. Class IfcDiscreteElement ... 321
20.15. Class IfcDistributionControlElement ... 322
20.16. Class IfcDistributionElement ... 323
20.17. Class IfcDistributionFlowElement ... 324
20.18. Class IfcDistributionPortGeometry ... 326
20.19. Class IfcElectricalAppliance ... 327
20.20. Class IfcElectricalFixture ... 328
20.21. Class IfcEquipment ... 329
20.22. Class IfcFlowController ... 331
20.23. Class IfcFlowEquipment ... 332
20.24. Class IfcFlowFitting ... 333
20.25. Class IfcFlowSegment ... 335
20.26. Class IfcFlowTerminal ... 336
20.27. Class IfcLightFixture ... 337
20.28. Class IfcPlumbingFixture ... 338
20.29. Class IfcRelAttachesElements ... 340
20.30. Class IfcRelConnectsPorts ... 340

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20.31. PropertySet Pset_24HourSchedule ... 341
20.32. PropertySet Pset_AggregateLoadInformation ... 342
20.33. PropertySet Pset_AirFilter ... 342
20.34. PropertySet Pset_AirHandler ... 343
20.35. PropertySet Pset_AirSideSystemInformation ... 344
20.36. PropertySet Pset_AirTerminal ... 346
20.37. PropertySet Pset_ApplianceThermalProperties ... 347
20.38. PropertySet Pset_Boiler ... 348
20.39. PropertySet Pset_BoundaryThermalProperties ... 349
20.40. PropertySet Pset_Chiller ... 350
20.41. PropertySet Pset_Coil ... 351
20.42. PropertySet Pset_Compressor ... 352
20.43. PropertySet Pset_Computer ... 352
20.44. PropertySet Pset_Convector ... 353
20.45. PropertySet Pset_CoolingTower ... 353
20.46. PropertySet Pset_Copier ... 354
20.47. PropertySet Pset_DistributionFluidFlow ... 354
20.48. PropertySet Pset_DuctDesignCriteria ... 355
20.49. PropertySet Pset_DuctFitting ... 356
20.50. PropertySet Pset_DuctSegment ... 356
20.51. PropertySet Pset_DuctSystemDesignCriteria ... 357
20.52. PropertySet Pset_ElectricalApplianceCommon ... 357
20.53. PropertySet Pset_ElectricalFixtureCommon ... 358
20.54. PropertySet Pset_ElementAccess ... 359
20.55. PropertySet Pset_Elevator ... 359
20.56. PropertySet Pset_EquipmentCommon ... 359
20.57. PropertySet Pset_EquipmentOccurence ... 360
20.58. PropertySet Pset_Escalator ... 360
20.59. PropertySet Pset_Facsimile ... 361
20.60. PropertySet Pset_Fan ... 361
20.61. PropertySet Pset_Faucet ... 363
20.62. PropertySet Pset_Fluid ... 364
20.63. PropertySet Pset_FluidMover ... 364
20.64. PropertySet Pset_GutterSegment ... 365
20.65. PropertySet Pset_HeatExchanger ... 365
20.66. PropertySet Pset_Insulation ... 366
20.67. PropertySet Pset_LightFixture ... 367
20.68. PropertySet Pset_LightingThermalProperties ... 367
20.69. PropertySet Pset_LoadDesignCriteria ... 368
20.70. PropertySet Pset_Material ... 369
20.71. PropertySet Pset_Motor ... 369
20.72. PropertySet Pset_OutsideDesignCriteria ... 370
20.73. PropertySet Pset_OvalDuctPort ... 370
20.74. PropertySet Pset_PackagedACUnit ... 371
20.75. PropertySet Pset_PipeDesignCriteria ... 372
20.76. PropertySet Pset_PipeFitting ... 373
20.77. PropertySet Pset_PipeSegment ... 373
20.78. PropertySet Pset_PipeSystemDesignCriteria ... 373
20.79. PropertySet Pset_PlumbingFixtureCommon ... 374
20.80. PropertySet Pset_PowerOutlet ... 376
20.81. PropertySet Pset_Printer ... 376
20.82. PropertySet Pset_Pump ... 376
20.83. PropertySet Pset_RadiantHeater ... 377
20.84. PropertySet Pset_RectangularDuctPort ... 377
20.85. PropertySet Pset_RoofDrain ... 378
20.86. PropertySet Pset_RoundDuctPort ... 378
20.87. PropertySet Pset_RoundPipePort ... 379
20.88. PropertySet Pset_Scupper ... 379

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20.89. PropertySet Pset_Shower ... 379
20.90. PropertySet Pset_Sink ... 379
20.91. PropertySet Pset_SiteWeatherData ... 380
20.92. PropertySet Pset_SoundPressureLevels ... 380
20.93. PropertySet Pset_SpaceElementInformation ... 381
20.94. PropertySet Pset_Telephone ... 383
20.95. PropertySet Pset_Toilet ... 383
20.96. PropertySet Pset_TubeBundle ... 383
20.97. PropertySet Pset_UnitHeater ... 384
20.98. PropertySet Pset_Urinal ... 385
20.99. PropertySet Pset_WindowCleaning ... 385

21. IfcSharedSpatialElements ... 385
21.1. Type IfcLossOrGainEnum ... 385
21.2. Type IfcOccupantTypeEnum ... 386
21.3. Type IfcRequirementOrCriteriaEnum ... 386
21.4. Type IfcResidentEnum ... 387
21.5. Type IfcUseCaseSourceEnum ... 387
21.6. Type IfcVisitorEnum ... 387
21.7. Class IfcFireCompartment ... 388
21.8. Class IfcOccupancyNumber ... 389
21.9. Class IfcOccupant ... 390
21.10. Class IfcRelOccupiesSpaces ... 391
21.11. Class IfcSpaceUseCase ... 392
21.12. PropertySet Pset_OccupantAssignee ... 393
21.13. PropertySet Pset_OccupantLeesee ... 393
21.14. PropertySet Pset_OccupantOwner ... 394
21.15. PropertySet Pset_OccupantTenant ... 394

Domain/Applications Model Layer

22. IfcArchitectureDomain ... 395
22.1. Type IfcBuiltInAccessoryTypeEnum ... 397
22.2. Type IfcCabinetTypeEnum ... 397
22.3. Type IfcCounterOrShelfTypeEnum ... 398
22.4. Type IfcRailingTypeEnum ... 398
22.5. Type IfcRampTypeEnum ... 399
22.6. Type IfcSpaceProgramTypeEnum ... 399
22.7. Type IfcStairTypeEnum ... 399
22.8. Type IfcVisualScreenTypeEnum ... 400
22.9. Class IfcBuiltInAccessory ... 400
22.10. Class IfcCabinet ... 402
22.11. Class IfcCounterOrShelf ... 404
22.12. Class IfcLanding ... 406
22.13. Class IfcRailing ... 407
22.14. Class IfcRamp ... 409
22.15. Class IfcRampFlight ... 411
22.16. Class IfcRelAdjacencyReq ... 412
22.17. Class IfcSpaceProgram ... 413
22.18. Class IfcSpaceProgramGroup ... 414
22.19. Class IfcStair ... 415
22.20. Class IfcStairFlight ... 417
22.21. Class IfcVisualScreen ... 419
22.22. PropertySet Pset_AccessoryCommon ... 421
22.23. PropertySet Pset_AccessoryDoorOrWindowHardware ... 421
22.24. PropertySet Pset_AccessoryPublicRestroom ... 422
22.25. PropertySet Pset_AccessoryUnspecified ... 422
22.26. PropertySet Pset_CabinetCommon ... 422
22.27. PropertySet Pset_CabinetOffice ... 423
22.28. PropertySet Pset_CabinetRestroom ... 423

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22.29. PropertySet Pset_CabinetStorage ... 423
22.30. PropertySet Pset_CabinetUnspecified ... 423
22.31. PropertySet Pset_Counter ... 424
22.32. PropertySet Pset_CounterOrShelfCommon ... 424
22.33. PropertySet Pset_RailingBalustrade ... 424
22.34. PropertySet Pset_RailingCommon ... 425
22.35. PropertySet Pset_RailingGuardrail ... 425
22.36. PropertySet Pset_RailingHandrail ... 425
22.37. PropertySet Pset_RampCommon ... 426
22.38. PropertySet Pset_RampElemented ... 426
22.39. PropertySet Pset_RampLayered ... 426
22.40. PropertySet Pset_RampSolid ... 427
22.41. PropertySet Pset_Shelf ... 427
22.42. PropertySet Pset_SpaceProgramCirculation ... 427
22.43. PropertySet Pset_SpaceProgramCommon ... 428
22.44. PropertySet Pset_SpaceProgramOccupied ... 428
22.45. PropertySet Pset_SpaceProgramOccupiedStandard ... 429
22.46. PropertySet Pset_SpaceProgramTechnical ... 430
22.47. PropertySet Pset_StairAccess ... 430
22.48. PropertySet Pset_StairCommon ... 430
22.49. PropertySet Pset_StairFire ... 431
22.50. PropertySet Pset_StairOrnamental ... 431
22.51. PropertySet Pset_VisualScreenAssembly ... 431
22.52. PropertySet Pset_VisualScreenCommon ... 432
22.53. PropertySet Pset_VisualScreenDoorOrGate ... 432
22.54. PropertySet Pset_VisualScreenPanel ... 432
22.55. PropertySet Pset_VisualScreenPost ... 433
22.56. PropertySet Pset_VisualScreenRestroomPartition ... 433
22.57. PropertySet Pset_VisualScreenRestroomPartitionDoor ... 433

23. IfcConstructionMgmtDomain ... 434
23.1. Class IfcCMDocPackage ... 434
23.2. Class IfcConstructionEquipmentResource ... 435
23.3. Class IfcConstructionMaterialResource ... 436
23.4. Class IfcConstructionZoneAggregationProduct ... 437
23.5. Class IfcCrewResource ... 438
23.6. Class IfcLaborResource ... 439
23.7. Class IfcProductResource ... 440
23.8. Class IfcRelAggregatesCrewResources ... 441
23.9. Class IfcSubcontractResource ... 441

24. IfcFacilitiesMgmtDomain ... 442
24.1. Type IfcFurnitureElementTypeEnum ... 442
24.2. Type IfcFurnitureTypeEnum ... 443
24.3. Type IfcInventoryTypeEnum ... 443
24.4. Type IfcOccupancyMoveTypeEnum ... 443
24.5. Type IfcWorkstationEnum ... 444
24.6. Class IfcFurniture ... 444
24.7. Class IfcFurnitureModel ... 445
24.8. Class IfcInventory ... 447
24.9. Class IfcOccupancySchedule ... 448
24.10. Class IfcOccupancyScheduleElement ... 449
24.11. Class IfcOccupancyTask ... 450
24.12. Class IfcRelNestsOccupancyScheduleElements ... 451
24.13. Class IfcRelNestsOccupancySchedules ... 452
24.14. Class IfcRelWorkInteraction ... 452
24.15. Class IfcSystemFurnitureElement ... 454
24.16. Class IfcWorkstation ... 455
24.17. PropertySet Pset_AssetInventory ... 456
24.18. PropertySet Pset_Chair ... 456

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24.19. PropertySet Pset_Desk ... 457
24.20. PropertySet Pset_FileCabinet ... 457
24.21. PropertySet Pset_FurnitureCommon ... 457
24.22. PropertySet Pset_FurnitureElementCommon ... 459
24.23. PropertySet Pset_Panel ... 459
24.24. PropertySet Pset_SpaceInventory ... 459
24.25. PropertySet Pset_Storage ... 460
24.26. PropertySet Pset_Table ... 460
24.27. PropertySet Pset_Worksurface ... 461

25. IfcHvacDomain ... 461

25.1. Type IfcActuatorFailPositionEnum ... 461
25.2. Type IfcActuatorTypeEnum ... 462
25.3. Type IfcAirTerminalBoxTypeEnum ... 462
25.4. Type IfcControllerTypeEnum ... 463
25.5. Type IfcDamperSizingMethodEnum ... 463
25.6. Type IfcDamperTypeEnum ... 463
25.7. Type IfcSensorTypeEnum ... 464
25.8. Type IfcValveEnum ... 464
25.9. Class IfcActuator ... 465
25.10. Class IfcAirTerminalBox ... 466
25.11. Class IfcController ... 467
25.12. Class IfcDamper ... 469
25.13. Class IfcSensor ... 470
25.14. Class IfcValve ... 472
25.15. PropertySet Pset_AnalogInput ... 473
25.16. PropertySet Pset_AnalogOutput ... 473
25.17. PropertySet Pset_BackdraftDamper ... 474
25.18. PropertySet Pset_BinaryInput ... 474
25.19. PropertySet Pset_BinaryOutput ... 475
25.20. PropertySet Pset_ControlDamper ... 475
25.21. PropertySet Pset_ElectricActuator ... 476
25.22. PropertySet Pset_FireDamper ... 476
25.23. PropertySet Pset_FireSmokeDamper ... 477
25.24. PropertySet Pset_HandOperatedActuator ... 478
25.25. PropertySet Pset_HvacController ... 478
25.26. PropertySet Pset_HvacSensor ... 478
25.27. PropertySet Pset_HydraulicActuator ... 479
25.28. PropertySet Pset_LinearActuator ... 479
25.29. PropertySet Pset_Louver ... 479
25.30. PropertySet Pset_MultiStateInput ... 480
25.31. PropertySet Pset_MultiStateOutput ... 481
25.32. PropertySet Pset_PneumaticActuator ... 481
25.33. PropertySet Pset_RotationalActuator ... 481
25.34. PropertySet Pset_SmokeDamper ... 482

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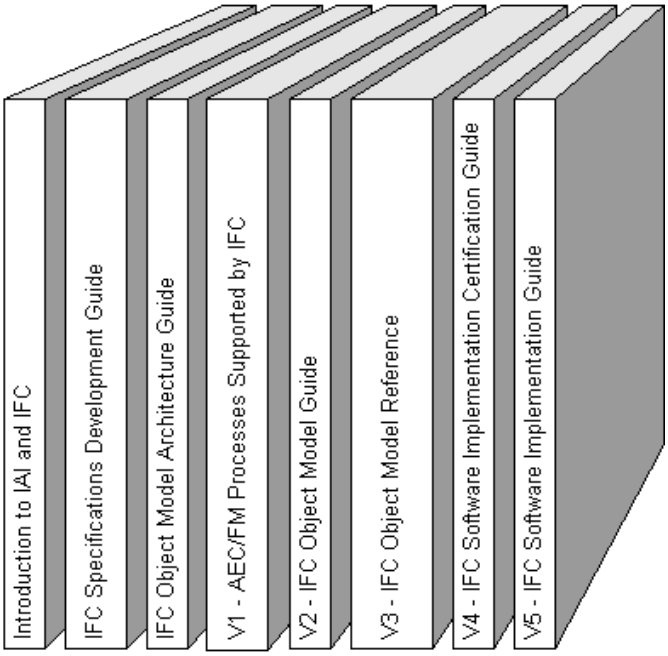
1. Introduction, Scope and Assumptions

1.1. Purpose of these documents

The purpose of this document suite is to provide a detailed specification of the Industry Foundation Classes (IFC) as defined by the Industry Alliance for Interoperability (IAI). The intended audience is the IAI membership, industry domain experts, and software developers interested in implementing IFC.

1.2. IFC Release Document Suite

IFC will be documented for two readers. The AEC professional and the software profession serving the AEC industry. Documents in this release include:



An Introduction to IAI and IFC

The "*An Introduction to IAI and IFC,"* as the name implies, provides AEC/FM industry professionals with an introduction to the organization, including its mission and organization. It also introduces the shared project model concept, end user benefits in using IFC compliant applications and summarizes the AEC Industry processes that are supported by this release of IFC. Finally, it provides a preview of what will be added in future releases.

IFC Specification Development Guide

The *"IFC Specification Development Guide"* defines the process used by the IAI in developing IFC. It also provides various references supporting parts of this process such as development of process diagrams, development of detailed requirement definitions and reading/creating EXPRESS (data model) definitions and EXPRESS-G diagrams.

IFC Object Model Architecture Guide

The *"IFC Object Model Architecture G*uide*"* defines the architecture used in the design of the IFC object model. This architecture is modular and layered which allows independent development and evolution of sub-schemata. This document is written for software developers who will develop applications supporting IFC.

Volume 1: AEC/FM Processes Supported by IFC

THIS DOCUMENT -- The "*AEC/FM Processes Supported by IFC"* volume documents the AEC/FM industry processes that the IFC Project Model in this release is designed to support. Therefore, this document effectively defines the scope of AEC project information included in this Release. Volumes 2 and 3 structure this information as software objects in AEC software. Note that this IFC release is limited to the information content of the foundation classes defined. Behavior for these objects, and thus the implementation of software that will support these AEC industry processes, will be defined by the implementing software vendors.

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Volume 2: IFC Object Model Guide

The "*IFC Object Model Guide"* defines model design and use concepts for IFC object model. These key concepts include: an overview of model architecture, capturing design intent, sharing semantic relationships, model extension by application developers. It also describes some implementation strategies such as file based model exchange, Client-Server architectures and runtime interoperability supported through standard software interfaces of the IFC model. This includes an overview and example of the physical file format for file based model exchange.

Volume 3: IFC Object Model Reference

The "*IFC Object Model Reference"* provides detailed definitions for each of the classes and data types defined in the IFC object model. This includes all of the information required by the AEC processes defined in volume 1, structured in an information model detailing object class data, relationships, standard interfaces, type definitions and geometry schema use for shape representation. Additionally, it provides a data model view defined in EXPRESS and a standard interfaces view defined in IDL. Each of these code sets will be used by application developers as input into Computer Aided Software Engineering (CASE) tools to semi-automate development of applications intended to support IFC. Finally, a on-line version of this information is provided in an HTML document set that is cross linked for easy access to information related to or supporting a particular class or data type.

Volume 4: IFC Software Implementation Certification Guide

The "*IFC Software implementation Certification Guide"* provides detailed information about conformance certifications issues and the methodology that will be used by the IAI to certify applications for multiple levels of IFC conformance. This includes an overview of the concepts for conformance assessment and certification, definition of various "Exchange Set" subsets of the IFC model for which certification can be assessed and an overview of the testing suites that will be used for certification testing.

Volume 5: IFC Software Implementation Guide

The "*IFC Software implementation Guide"* provides detailed information addressing the issues of implementing the IFC object model in software products. In this release, it's content is limited to the topics of implementing property sets (previously called "Pset Guide") and the differences from the previous release (previously called "Migration Guide"). Over the next couple of IFC releases, many more topics will be addressed.

1.3. Scope

1.3.1. Scope for IFC Release 2.0

Enabling interoperability between applications by different software vendors is the ultimate goal of the IAI. This is a very ambitious goal and will be achieved through a series of incremental steps.

In general, the IAI is focused on providing three things in IFC:

1. Standard definitions for the attributes associated with entities comprising an AEC/FM project model (objects)
2. Structure and relationships between these entities from the point of view of various AEC/FM professionals
3. Standard formats/protocols for two methods of sharing this information:
   - *exchange via a standard file format*
   - *exchange via standard software interfaces*

It is important to note that the software interface specifications in this release will not include any application-specific behavior. Instead, these interfaces will be limited to get and set methods for the attribute and relationship information defined in the data model.

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Release 1.5 of IFC provided the infrastructure that supports this release, plus reasonable models for architecture, some HVAC, estimating, scheduling and Facilities Management. This release will build on these foundations and extend the model in several areas.

The scope for this release of the IFC Specifications is limited to:

1. Six AEC/FM domains - Architecture, HVAC engineering, codes and standards, cost estimating, facilities management and simulation
2. Only a specific subset of the processes in these domains (defined in Volume 1 of these specifications).

These domains and processes are:

Architectural Design

- *Building 'shell' design*
- *Building 'core' design*
  - *Stair design*
  - *Public toilet design*
- *Roof design*
- *Fire Compartmentation*

HVAC Engineering

- *HVAC Duct System Design*
- *HVAC Piping System Design*
- *Pathway Design and Coordination*
- *Building Heating and Cooling Load Calculation*

Codes and Standards

- *Commercial and Residential Energy Code Compliance Checking*

Cost Estimating

- *Cost Estimating*
  - *Identify Objects*
  - *Identify Tasks Needed to Install Objects*
  - *Identify Resources Needed to Perform Tasks*
  - *Quantify*
  - *Costing and Cost Summarization*

Facilities Management

- *Property Management*
  - *Enabling the use of IFC objects in property management*
  - *Grouping IFC objects*
  - *Linking the maintenance objects to the IFC objects*
- *Occupancy Planning*
- *Design of Workstations*
- *Floor Layout of Workstations for an Open Office*

Simulation

- *Photo Accurate Visualization*

All AEC domains

- *Document references (from model to document only)*

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1.3.2. Scope of this document

This document includes the following information:

1. **Introduction, Scope and Assumptions**

   This section provides the reader with an introduction to the set of seven documents comprising this release of the IFC Specifications. This section outlines the information included in this document versus related documents. It will also define the scope for this release and assumptions about knowledge of the reader.

2. **Resource Layer Schemata**

   This section contains the detailed specifications for IFC model objects and data types. There are 11 schemata in this model layer - document sections 2-12.

   - *Specifications for static elements of the model:*

     Custom data types
     - Defined data types
     - Enumerations

     Classes
     - Semantic definitions
     - Attribute and Relationship definitions
     - Type definitions
     - Interface definitions
     - Geometry use definitions
   - *Specifications for dynamic data extension elements of the model:*

     PropertySets
     - semantic definitions
     - Attribute and Relationship definitions
     - Interface definitions

3. **Core Layer Schemata**

   This section contains the same detailed specifications as as above, but for the Core model layer. There are 6 schemat in this model layer - document sections 13-18.

4. **Interoperability Layer Schemata**

   This section contains the same detailed specifications as as above, but for the Core model layer. There are 3 schemata in this model layer - document sections 19-21.

5. **Domain/Application Models Layer Schemata**

   This section contains the same detailed specifications as as above, but for the Core model layer. There are 4 schemat in this model layer - document sections 22-25.

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1.4. Assumptions and Abbreviations

This document assumes the reader is reasonably familiar with the following:

- AEC/FM market and project terminology
- Software industry terminology
- Concepts and terminology associated with object oriented software

The following abbreviations are used throughout the IFC Specifications:

- AEC/FM Architectural, Engineering, Construction and Facilities Management
- IAI Industry Alliance for Interoperability
- AP Application Protocol
- Arch Architecture
- CM Construction Management
- CORBA Common Object Request Broker Architecture
- COM Microsoft's Component Object Model
- DCE Distributed Computing Environment
- DCOM Microsoft's Distributed Component Object Model
- DSOM IBM's Distributed System Object Model
- FM Facilities Management
- FTP File Transfer Protocol
- GUID Globally Unique Identifier
- HVAC Heating, Ventilating and Air Conditioning
- HTTP Hypertext Transport Protocol
- IAI International Alliance for Interoperability
- IDL Interface Definition Language
- IFC Industry Foundation Classes
- ISO International Standards Organization
- FM Facilities Management
- MIDL Microsoft's Interface Definition Language
- ODL Microsoft's Object Description Language
- OMG Object Management Group
- ORB Object Request Broker
- OSF Open Software Foundation
- RPC Remote Procedure Call
- SOM IBM's System Object Model
- STEP Standard for the Exchange of Product Model Data
- TCP/IP Transmission Control Protocol/Internet Protocol
- TQM Total Quality Management
- URL Universal Resource Location

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1.5. International Alliance for Interoperability (IAI)

The IAI is a 'not for profit' industry alliance of companies. Its membership is comprised of visionary companies representing all sectors of the AEC industry worldwide.

The IAI was first formed in September of 1995, by 12 industry leading companies who, during the previous year had worked together to develop proof of concept prototypes demonstrating the viability of interoperability between AEC software applications. This demonstration was shown publicly at the AEC Systems '95 conference in Atlanta, Georgia. This is the third release of IFC since that time. There are currently 50 organizations implementing software to support IFC, a number that is growing quite rapidly now.

As of this printing, the IAI includes 9 international chapters with hundreds of member companies in the following regions:

- Australasian countries
- French speaking region of Europe
- German speaking region of Europe
- Japan
- Korea
- Nordic countries of Europe
- North America
- Singapore
- United Kingdom

The IAI stated Vision, Mission and Values can be summarized as:

VISION

Enabling Interoperability in the A/E/C/FM Industry

MISSION

To define, promote and publish specifications for the Industry Foundation Classes (IFC) as a basis for information sharing through the project life cycle, globally, across disciplines and technical applications.

VALUES

- Not for profit industry organization
- Action oriented (Alliance v. Association)
- Consensus based decision making
- Incremental delivery (rather than prolonged study)
- Global solution
- Industry to define IFC
- IFC to be "open" (for implementation/use by all software vendors)
- Design for IFC to be extensible
- IFC will evolve over time
- Membership open to any company working in construction industry

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