Autodesk® 3ds Max Design – The Designer's Handbook

Notes from the course Architectural Design using Autodesk® 3ds Max Design

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File Name and Path: E:\Teaching\The Designer Handbook\Autodesk® 3ds Max Design – The Designer's Handbook.odt

Modified Date: 08/29/19

This book is dedicated to my mother.

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1 Navigating the 3ds Max Scene

This chapter introduces the working environment, the reference systems used inside the 3ds Max scene and methods for navigating the scene. The User Interface is also presented with available tools for user customization.

1.1 The 3ds Max Scene

The 3ds Max Scene is a digital file with extension .MAX and can be considered as a container of digital models, cameras, materials, environment settings, rendering settings, animation and more. In the 3ds Max Scene definition of space is accomplished using a Reference System of coordinate axes XYZ. Objects can be created in the scene as native 3ds Max objects or imported from other applications (see 5.1).

In some cases the 3ds Max Scene may require assets (external files) in order to function properly, e. g., a material in the scene using external bitmaps. Locations of assets are recorded in the scene file and required external files need to be available at the recorded addresses or in the same folder where the scene file is located.

The 3ds Max Scene file contains models used for the production of graphics, lighting simulations and, with the use of MAXScript, data extraction extending the purpose of 3d models to act as a building information database (BIM).

AEC software focus on specific aspects of design work, Autodesk® Revit on data management and extraction, Autodesk® AutoCAD on precise 2D drafting and Autodesk® Inventor on topology accuracy. 3ds MAX can be considered as a powerful modeling tool with rigorous and highly advanced visualization and simulation capabilities. 3ds MAX is often used in combination with the above mentioned software.

3ds MAX uses meshes[1] to define geometry objects and does not support solids, objects can still behave similarly to solids as in the case of Boolean compound objects (see 2.2).

Meshes can be converted into Polygonal objects (e-poly) that provide a more comprehensive tool set for surface manipulation. We will see in the next chapters how, manipulating basic geometry objects (Primitives), the designer will be able to achieve complex geometry, with the level of definition depending on project's requirements and computing resources budget. A well known technique, commonly referred to as Box Modeling, uses the lowest possible number of surface polygons and while it has been traditionally used for the production of

1 *See in regards to the definition of mesh the documentation of the Finite Elements Theory of Prof. R. L. Taylor that can be found at the FEAP page on Berkeley University website.*

low-poly models in the video-game industry it can be also used as reference for the production of models used for architectural visualization, particularly for the production of walk-through animations.

1.2 World and Local Coordinates Systems and Concept of Creation Plane

Definition of the space inside the 3ds Max scene is based on an unmovable system of coordinate axes XYZ; the three axes define 3 planes commonly used as Creation Planes for objects. These XYZ axes represent the **World System**; in order to locate objects in the space it becomes necessary to define an object's based **Local Reference System**, the origin of which is located in the movable[2] **Pivot Point** of an object which, through its World System coordinates, defines the location of objects in the scene.

Objects are often created using one of the three World System planes (X-Y, X-Z & Y-Z) as the **Creation Plane** or using custom oriented **Grids**, objects similar to UCS in Autodesk® AutoCAD and reference planes in Autodesk® Revit (see 2.2). The object's dimensional parameters are oriented in reference to the Creation Plane, e. g., the direction of a box dimensions will be initially set as parallel to the axes of the World Reference System or the Local Reference System of an active Grid.

A clear understanding of the concept of Creation Plane is fundamental when manipulating objects in 3D.

1.3 Units Setup and Distance from the Origin Factor

Although 3ds Max is designed to use inches as Units (this aspect becomes particularly evident when using AEC Design Elements), these can be set to represent different values using **Units Setup** (Customize menu). Units are typically defined at the beginning of a project according to the project's scale and will be typically large (feet, meters) when working with landscape or urban design models, or small (inches, centimeters) with architectural models. As a general rule, significant details of the model should not be considerably smaller than the scene unit.

The distance of objects from the origin of the World System needs to be taken into consideration as both round-off errors affecting the navigation of the scene and rendering time increase with it. To avoid these problems it is always advisable to locate the center of the overall model in the proximity of the Origin of the World System (X=Y=Z=0).

2 *Transforms can be applied to the Local Reference System using: Hierarchy Panel, Affect Pivot Only.*

1.4 Scene Navigation

Navigating the scene in a smooth and efficient way is crucial as it allows seamless modeling using visual feedback from the model; 3D objects need to be viewed from different angles, similarly to a sculptor who continuously examines his work from different points of view while making the desired adjustments. **Arc rotate**, **Pan**, **Zoom** are the commands available for this purpose and they can be transparently invoked (during the execution of a command) using the mid mouse button (MMB) in combination with Shift, Ctrl and Alt keys.

Development of an efficient work flow using navigation shortcuts is key for the production of architectural models.

Other commands available for scene navigation are: **Isolate Tool** (Alt-Q) used to temporarily hide all objects except for the selected ones, **Zoom Extents Selected** (Z), **Pan Viewport** (I) used to center the viewport at the mouse pointer location and the **Walk Tool** that simulates walking/flying through the scene.

Using Zoom Selected is also a quick method to re-adjust the mouse wheel zoom increment as this occasionally uses different values during scene navigation.

Navigation commands can also be used in the work flow to establish camera locations, see 7.2.

1.5 Viewports

Viewports are used to represent the content of the scene using perspective or orthogonal views. The viewport's representation can use different techniques called Visual Styles, the most relevant ones being: wireframe, smooth and highlights, edged faces, hidden-line and realistic. It is advisable to use edged faces (F4) as this visual style allows full understanding of topology features and the geometric complexity of the model. Scene Lights Shadows and other advanced features and visual effects, e. g., ambient occlusion, can be enabled for an additional level of realism, of course at the cost of computer performance which is manifested in terms of viewport refresh rate. Scenes populated with a large number of objects (or containing objects with a high number of polygons) tend to become more difficult to navigate. When working with highly detailed models it is possible to improve the viewport's performance using less resources demanding visual styles, enabling **Adaptive Degradation** and turning off the visibility of the Home Grid (G).

1.6 Command Input and Customizing the User Interface

Commands in 3ds Max are invoked using keyboard shortcuts called **Hotkeys**, selecting **menu** items, and pressing **toolbar** buttons. In regards to buttons the user should be aware that, in some cases, the command is executed using left click and settings for the specific command are accessed using right click on the same button. Some buttons, when pressed without releasing will expand into a number sub-buttons with additional related commands and features.

In the opinion of the author, the use of hotkeys represents the most efficient work flow. Custom hotkeys, menus and toolbars can be defined using the **Customize User Interface** dialog. **Quad menus** are also a valid alternative method for executing commands; right clicking on an object in the viewport will bring up an adaptive list of available commands on the specific selection.

Experienced users usually use a combination of all the above mentioned methods depending on personal preference and task related convenience. **Expert Mode** (Ctrl-X) hides temporarily all toolbars and the command panel maximizing the screen space for viewports, this mode is useful when the user is familiar with executing commands with hotkeys, menus and quad menus and can be used with **Grab Active Viewport** to maximize the size of viewport screenshots (or animated sequences) to be exported.

An important element of the user interface, often accessed when manipulating objects, is the **Command Panel**, by default located on the right side of the screen and divided into six sub-panels, it mainly provides tools for creating and modifying objects, see chapter 4. The Command Panel is subdivided in: Create, Modify, Hierarchy, Motion, Display and Utilities sub-panels. Explanation of the use of these panels is discussed in the next chapters.

2 Object Management

Proper management of the model is crucial for data usability and validation of design intents. This chapter will present objects typically used to create models for architectural visualization and how scene objects can be organized according to typical AEC standard production requirements.

2.1 File Management

When starting a new project it is advisable to create a directory that will contain the project files and all assets needed for the production; **Set Project Folder** is used for this purpose.

The typical procedure for archiving a project or sending files to consultants uses the **Archive** command, this will conveniently compress the scene file with all required assets into a single .zip file so it can be opened on other computers.

3ds Max allows using externally referenced 3ds Max files, this is accomplished using **X-ref Objects** and **Scenes**. Individual objects or entire scenes can be referenced into one file. X-ref objects or scenes are neither selectable nor editable. X-ref scenes can be used to split the working file allowing more users to work on the same project at the same time using shared coordinates (similarly as Worksharing in Autodesk® Revit).

2.2 Object Creation and Types of Objects

All 3ds Max native objects depend on specific parameters, more or less parameters will be available depending on the nature of the object. Parameters can be subdivided in two classes: dimensional parameters (radius, height, width and length) and subdivision parameters (number of segments and polygons in which objects are subdivided). The results of the second category of parameters is not visible in the viewport unless the Viewport Visual Style is set to show object's edges (Wireframe, Edged Faces and Hidden Line). **Parametric Objects** are editable using the parameters value fields found in the modify panel. Another important aspect to take into consideration when using parametric objects is that values assigned to parameters can be used to provide data for future extraction, see an example of data extraction in chapter 9.

Custom parameters can be assigned to any object in the scene using **Parameter Editor** (Alt+1) in reference to subsequent attribute extraction routine to be executed on the model.

3ds Max objects are subdivided in categories and subcategories, all listed in the **Create Panel**. Creation of objects is accomplished pressing the appropriate object's button in the Create Panel, then click and drag in the viewport to dynamically set values of the parameters available for the given object. It is a common procedure to create a roughly sized placeholder object in the viewport, and then further adjust its parameters using the appropriate numerical fields in the modify panel, as an alternative, a keyboard entry group is available on the create panel to precisely set the object's location and parameter values on creation.

Geometry and **Shapes** are the types of objects used for modeling. Geometry objects are volumetric three-dimensional objects while Shapes are lines, often used in combination with modifiers to create three-dimensional objects. A special type of object, usually obtained by converting previously created parametric objects or imported geometry is the **Editable Poly**. The most relevant difference between Editable Poly and Parametric Objects is that Polys have no parameters or recorded object's history therefore any modification to the geometry needs to be done either applying modifiers or editing at the appropriate sub-object level. While this aspect might be considered as a limitation, we will see in the next chapters that this actually represents a key feature for free-form modeling.

An important subcategory of geometry objects is **Compound Objects**, of which the most relevant for architectural models are: **Boolean**/**ProBoolean** and **Shapemerge Objects**.

Boolean is a type of object that allows subtraction, intersection and union of volumes from the combination of several geometry operands. It is important to note that the individual operand's parameters remain available after creation of a boolean object expanding the modifier stack in the modify panel (see 4.1). ProBoolean is an advanced version of Booleans and it is used for identical purposes.

Shapemerge Objects are used to project 2D shapes onto 3D surfaces, usually to split surfaces or cut out shapes (for example a road on a terrain) or simply to refine the surface subdivision to allow specific sub-object selection. The creation of a shapemerge object is a resource intensive calculation and therefore it is advisable, when possible, to simplify both the surface and the projected spline to avoid potential problems with the subsequent automatic sub-object selection.

The behavior of compound objects is directly dependent on the quality of the operands, good quality of objects being considered the absence of geometry errors. These errors can be: double faces, open edges, multiple edges and isolated faces (see 4.3 in regards to Editable Poly Objects). When working with compound objects it is advisable to check each operand when the result is not as expected (holes in the mesh). The **STL Check Modifier** is used to check if any errors are present within the object. Another method to test the quality of selected objects is enabling **xView** (found under views menu) that displays results inside the viewport. Exporting objects to an OBJ file will also report any incongruity found in the model.

AEC Design Elements are parametric objects that represent actual construction components such as windows, doors, walls & stairs. When working with AEC Design Elements it is important to keep in mind that this category of geometry objects is designed to work in combination with specific AEC material templates, see chapter 6.

The **Section Object** can be found under the shape objects category and it allows cutting sections through objects generating the corresponding cut spline. The actual section object simply represents the current location and orientation of the cutting plane, it is not a Shape object itself but it allows creating section splines when pressing the appropriate button in the modify panel. The section object can be used to generate plans and sections from 3ds Max models, the section splines obtained with this method can then be exported to CAD applications.

Helpers are non-renderable objects that can be considered as the digital modeler's construction tools. **Grids** are helper objects that can be created permanently into the scene and activated to use as custom reference systems for object creation. Temporary grids, parallel to faces of objects in the scene, are used on object creation when enabling the **Autogrid** option.

2.3 Object Management

The **Object Properties** dialog, found under the Edit Menu or in the Quad Menu, allows editing the Display and Rendering Control Properties, e. g., the object's wireframe color, initially assigned with default values at the time of object's creation.

The procedure of setting the Display and Rendering Control Properties of objects "by Object" has been popular with older releases of 3ds Max. Display Properties editing was then accomplished using the **Display Panel** editing the Hide/Show, Freeze/Unfreeze Properties of individual objects. This functionality has been maintained but fell into disuse after the introduction of **Layers** and the **Manage Layers** function available within the Layers Toolbar. With this interface the user can toggle the visibility on and off, freeze and unfreeze all objects of entire layers as well as individual objects. Given the assumed user's familiarity with layer based vector programs, it is nowadays advisable to use, as office standard practice, management of scene objects with the Manage Layer interface rather than the Display Panel.

Clones can be created from existing objects following two alternative procedures: using the hotkey Ctrl-V that generates clones in the same location of the source object or dynamically, using the **Select and Move Tool** in combination with the **Shift key**; this way the clones will be equally spaced in the direction of the move transform, using as interval the specific move transform value applied. Clones can be created as three different types: **Instance, Copy**, and **Reference**. When using Instances children clones maintain a reference to the parent object so that modifiers, sub-object edits, modifiers and material assignment subsequently applied to either the parent or any of the children will propagate to all children and the parent. Copies are simple Clones that maintain no reference with any children or parent objects. References can be considered as one-way Instances in the sense that modifiers applied to the parent will propagate to all children but modifiers applied to any of the children will not propagate to the parent or any other children. Note that in regards to objects parameters (e. g., for a box: length, width, height and number of subdivisions) and material assignment, References behave exactly as Instances. When needed, Instance Clones can be converted to Copies using the Make Unique button found in the Modify Panel right below the Modifier Stack.

In some cases, e. g., when modeling furniture, elements will be represented by an assembly of several components, **Groups** can then be used to allow selection of multiple objects as one entity. Organizing scenes with groups is usually advisable as it facilitates scene navigation and object selection. Groups can be opened and closed to access each individual component objects. An alternative method to using groups is to attach objects using the edit poly modifier (see chapter 4), this procedure often requires the use of a multi sub-object material (see chapter 6).

2.4 Object Resolution Considerations

Before starting to model any object the following aspects need to be taken into consideration in order to establish the required level of detail: what will be the closest distance from which the object in question will be seen in production renderings? What level of detail is required to render properly and to adequately serve the purpose of visualization or data extraction? How important is the object in question in relation to the entire scene? Obviously, answers to some of these questions are not always available at the early stages of a project but the user will be able to make at least some educated prediction. A typical beginner's mistake is to spend long hours modeling into great detail objects that might not be visible in final production renderings, it is therefore advisable to review the scope of work to make sure that the modeler has, as much as possible, a clear understanding of the visualization project's intent and the predictable future use of the model.

3 Object Selection and Transforms

Selection and adjustment of transform values often require a consistent amount of time during production, this chapter will introduce methods and tools used to expedite this process while maintaining the level of precision required for AEC models.

3.1 Object Selection

A fundamental action continuously executed when working on a model is selecting objects or parts of objects to apply **Transforms** and to modify their Properties and Parameters. Object selection can be achieved using the **Select Object** command via left click on objects in viewports or selecting by name using the **Select by Name** (H) dialog with a list of objects contained in the scene and the option to filter objects by category. Objects in 3ds Max Design can be identified using their names, e. g., box01, cylinder01, line01 etc... These default names are generated on creation according to the object's type, it is in some cases advisable to review these names and rename objects using more meaningful terms, e. g., exterior_wall01, table01, canopy_glass01, curtain_wall_panel01. Objects can be renamed using the appropriate field in the Modify Panel or on multiple objects selections using the **Rename Objects** utility, see chapter 4 – Tools and Utilities.

Executing specific selections manually using the common procedure with the mouse left click in combination with **Ctrl** and **Alt** keys to add and remove objects from the selection can be time consuming. It is important to note that, unlike other software, 3ds Max Design records selection actions in the undo list allowing corrections on the current selection. **Window/Crossing** is a toggle that allows switching between two mouse drag-selection modes: dragging over the full extents of an object in the viewport (Window) or just a portion of it (Crossing). Selections of multiple objects can also be saved for reuse in future sessions using the **Named Selection Sets** dialog. **Selection Filters** are another tool used to simplify the selection process restricting individual types of objects to be selected. This feature becomes particularly useful when specific tasks, e. g., placement of light objects, 2D spline editing etc..., are executed and the user wants to make sure that objects of other categories of objects will not be modified by mistake.

Objects should be neatly assigned to specific **Layers**. The layers Toolbar can be enabled choosing from the list available when right clicking on the Main Toolbar, this interface allows editing layers properties such as visibility, wireframe color and render properties. Objects imported from DWG drawings will maintain their layer designation, it is therefore advisable using similar, if not exactly the same, layers organization standards already established in the office for the production of construction documents[3]. Selection by layer is another powerful method of selection that becomes available to the user when objects in the scene are organized with layers.

Experienced users will further refine their work flow reducing the time required for complex selections to a minimum; on large projects time spent purely on objects selection can be consistent, therefore it is strongly advisable to organize scene objects using layers and in some cases assigning object names that are meaningful and in reference to the specific discipline they pertain to, e. g., introducing a specification section number as a prefix in the objects names. This practice has also a positive impact on any subsequent data extraction procedure when object's parameters and attributes will be associated with object names therefore allowing additional sorting options when working with exported spreadsheets.

3.2 Object Transforms

In order to set the location and orientation of objects, the following **Transforms** can be used: **Move** (W) and **Rotate** (E). Transform values can be entered either dynamically, manipulating the **Gizmo** within the viewport, or using the **Transform Type-in** (F12), a dialog box reporting the world system coordinates and rotation angles of the pivot point of the selected object. Values can be entered using absolute or relative values, specified by increments.

The Gizmo (X is the hotkey to toggle its visibility), a visual feature shown in the viewport whenever and object is selected, is used to mark the location of the object's pivot point therefore the origin and orientation of the local coordinate system. The three axis and planes of the gizmo are also used to apply transforms using the **Axis Constraints**, limiting the movement of an object in specific directions parallel to the reference system axes and planes. An axis constraint is selected either left clicking on the highlighted gizmo axis or plane or using the F5, F6, F7 and F8 hotkeys. The axis constraints feature needs to be enabled under the options tab of the grid and snaps settings dialog, when used in combination with Snaps it is a convenient and precise method for placing and aligning objects in reference to other features in the scene.

Using the **Reference Coordinate System Pull Down Menu** located on the Main Toolbar Object transforms can be applied in reference to the world system as well as other reference systems, the most relevant being the local system, particularly useful when editing at the sub-object level of e-poly objects with polygons not parallel to the world system.

3 *Search on line for the most recent version of the AIA CAD Layer Guidelines in regards to standard layer naming convention.*

Snaps (S is the hotkey used to toggle Snaps on and off) are a fundamental feature when applying transforms using the Gizmo, they act like magnets located at specific features of objects. The most popular snaps are vertex and midpoint but others can be enabled via the **Grid and Snaps Settings** dialog (right click on the snaps button on the main toolbar). Snaps can be used in three different modes: **2D** ignoring any features not contained in the active grid (default XY plane of the world system for perspective views), **3D** using features at any location and **2.5D** using the projected location of 3D features onto the active grid. The 2.5D Snap is particularly effective when creating 2D splines using orthogonal views while tracing splines using snaps on three dimensional objects features.

An **Angle Snap** is available when using the gizmo for applying rotation transforms to objects using angle increments. The value of the increment can be specified in the grid and snaps settings dialog. The rotate transform can be applied to objects using the pivot point as center of rotation or any other snaps features when using **Selection Center** or **Transform Coordinate Center**, the user can switch between these modes using the button located on the main toolbar, the default mode is pivot point center.

When applying move transforms using snaps and axis constraints it is important to remember that selection is an action recorded in the undo list and can be reverted simply using the hotkey Ctrl-Z, note also that this does not apply to changes in the axis constraint selection; to avoid selecting objects in the background it is sometimes useful to temporarily lock the selection using the space bar toggle hotkey.

Particularly when working with complex scenes populated by a large number of objects, the user will need to acquire familiarity with the use of snaps and axis constraints, with practice using these features, the user will develop an efficient technique to move objects precisely in the scene.

The **Scale**, transform can be applied using both the gizmo and the transform type-in, percentage scale factors can be entered for the three directions of the local system, non-uniform scale is also possible. To remove all Rotation and Scale values from selected objects the Reset XForm utility can be used, see chapter 5. The gizmo's axis constraints feature is available for this type of transform as well and, apart from the typical use on individual objects, scale can be applied also at the sub-object level on a selection of vertices with the result of flattening portions of an object's surface.

4 Modeling

When objects are created using primitives or meshes are imported into a scene it is often necessary to modify, refine or simplify their geometry, fundamental concepts and tools in regards to these tasks are presented in this chapter.

4.1 Concept of Sub-object Level

When we need to modify the geometry of objects we can either edit the object's parameters, apply modifiers or edit at the Sub-object level when using editable splines, editable poly objects and, in a similar way, modifiers and compound objects. The sub-object levels are accessible through the modify panel expanding the corresponding level in the **Modifier Stack**. Depending on the type of object selected, different types of sub-object levels will be available. The user will develop the required knowledge to understand which specific sub-object level would result as the more appropriate to be used to achieve desired geometry modifications. The move, rotate and scale transforms can be applied to elements or selections of elements at sub-object levels such as vertex, segment, edge, border, face and polygon, modifying the overall geometry of the object.

Modifiers have some sort of sub-object level (gizmo, center) that can be used to locate the center of application and orientation of the modifier, see paragraph 4.4 in regards to modifiers.

4.2 2D Splines

Editable Splines can be created either converting any parametric shape object into a spline or creating Line Objects available in the create panel.

The sub-object levels available with editable splines are: **vertex**, **segment** and **spline**. When editing splines the modify panel gives access to a number of editing tools, the most relevant being:

Vertex sub-object level - **Vertex Types** controls the vertex type, available types are Corner, Bezier-Corner that both create a point of discontinuity in the spline, Smooth that defines a non-adjustable continuous curve and Bezier for adjustable continuous curve using tangent handles. When working with Bezier corners tangent values can be copied and pasted on other vertices using the Tangent group inside the modify panel. Other common 2D vector spline editing commands are available such as **Fillet**, **Chamfer** and **Weld** (used to collapse multiple vertices into one single vertex using a specified threshold distance). **Refine** can be used to create new vertices inside a given spline.

Segment sub-object level – Segment properties such as Line or Curve can be specified using the upper-left quadrant of the quad menu (note that this works only when used in combination with either smooth, bezier or bezier corner vertex type on the segment's end vertices). Segments can be divided into a number of smaller portions creating new equidistant vertices using the **Divide** button.

Spline sub-object level – Compound Shapes are made of multiple splines attached together. When using compound shapes it is possible to access individual splines at the sub-object level. Common 2D vector spline editing commands can be applied at the spline sub-object level such as: generating an **Outline** of a selected spline using a specified distance, **Trim** and **Extend**, **Mirror**, **Boolean Union**, **Subtraction** and **Intersection**.

Attach/Detach is used with compound shapes to attach or detach splines.

When working with architectural models the user will sometimes use splines already generated for project documentation, e. g., imported CAD files of architectural plans and elevations, fine tuning and adjustment of the imported splines is often a required task.

Splines can also be used as renderable objects with round or rectangular sections of adjustable radius or length and width and an angle of rotation of the section.

4.3 Editable Poly Objects

The most advanced and ductile type of geometry object is the **Editable Poly**, also called **Polymesh** object. Epoly objects are usually obtained converting other types of geometry objects, e. g., parametric objects and meshes. Converting a parametric object to a Poly removes access to the original object's parameters, applying the Editable Poly Modifier maintains access to the base object parameters, see 4.4 in regards to the Editable Poly Modifier.

Poly objects are defined by polygons that are surface elements connecting three or more edges. The reader can imagine polygons as surfaces opaque on one side and transparent on the other. These surfaces are oriented according to the direction of the normal, a vector perpendicular to the surface, the orientation of this vector defines which of the two sides of the surface will receive and reflect light (note that surfaces can be rendered as transparent applying a transparent material, see chapter 6). Polygons with normals oriented towards the interior of the object represent a typical geometry error, in this case the Normal Modifier can be used to unify the normals of an object's polygons.

Similarly as with Editable Splines, the geometry of Poly objects is controlled using the following sub-object levels: Vertex, Edge, Border, Polygon and Element. Each sub-object level provides specific tools, the most relevant being:

Vertex sub-object level – **Weld Vertices** (similar tool as what already seen with

Editable Spline) commonly used to close open edges, considered as geometry errors and therefore causing rendering artifacts and unpredictable behavior when objects are used as operands of compound objects.

Edge sub-object level – **Ring** and **Loop selections** provide an advanced type of edge selections where the initial selection of one edge can be extended to a group of parallel edges all around the object (Ring) or all edges aligned with the selected one (Loop). **Chamfer** (note that this command applies to vertex as well) is used to produce a diagonal cut on edges. Edges of Epoly objects can be used to generate new splines using **Create Shape From Selection**.

Border sub-object level – This type of selection is used mostly to fill holes in the surface using **Cap**. Create Shape From Selection can be used also at Border sub-object level.

Polygon sub-object level – Given the nature of the object, the most significant tools are available under polygon sub-object level. **Cut** is a tool used to subdivide polygons creating new edges, **Slice plane** is a tool used for the same purpose but using a slicing plane on selected polygons. **Bridge** is a tool that allows connecting the edges of selected polygons creating a bridge between them. Parameters can be interactively set for the number of segments, taper, bias, smooth and twist. Bridge can also be used to remove object's volume between selected polygons. **Flip** is used to invert the orientation of the normals. Other useful tools available at the sub-object level are Bevel, Extrude, Outline, Inset, Hinge from edge and Extrude along spline.

The **Element** sub-object level allows selecting and applying transforms to any volumetric entities of which an Epoly may be composed of.

Attach allows attaching other objects that become Elements of the current poly object.

A number of other useful features available with most sub-object levels are:

Convert Selections which allows to transfer selections holding the Ctrl key while switching between sub-object levels.

Delete (delete) is used to delete selected elements. Note that when using delete on vertices or edges the neighbor polygons are deleted as well creating openings in the object's surface. **Remove** (backspace) allows removing vertices, polygons or edges without creating openings in the surface.

Soft Selection is a special method of selection that allows extending transforms to neighbors of selected elements. The transform applied to the neighbor's elements is scaled depending on the distance (falloff) from the selected elements and according to a customizable symmetrical curve.

Graphite Tools is a collection of tools for editing Epoly objects that can be found in the dedicated toolbar. Some of the tools in this toolbar are already available in the Modify Panel but others are included to allow special methods of selection. The reader is strongly encouraged to explore these tools the description of which can be invoked simply hovering the pointer over the toolbar's buttons.

NURMS (Non-uniform rational mesh smooth) is an algorithm applied to low-polygon meshes to display them as high-polygon smoothed meshes. The algorithm is designed to be used in combination with a modeling technique called box modeling where objects are modeled with the lowest possible number of polygons, the object's surface is then represented by a new collection of polygons obtained by the interpolation of the initial ones, the number of iterations can be adjusted to increase the level of detail of the resulting surface. NURMS are typically used to represent smooth free-form organic surfaces.

4.4 Modifiers

Modifiers are applied to objects to modify their geometry or mapping coordinates. Multiple modifiers can be applied to a single object, the effect of each modifier is applied in the order of application as indicated in the **Modifier Stack**, located inside the modifier panel, used to edit parameters of specific modifiers, reordering the list, copying and instancing and switching on and off individual modifiers and converting instanced objects and instanced modifiers to unique copies (see paragraph 2.3 in regards to clones). Applying a modifier to a selection of objects automatically creates instanced modifiers.

The adaptive pull down list of modifiers, located immediately above the modifier stack, provides access to all modifiers available for the selected object. Modifiers that can not be applied to the selected object will not be included in the list (e. g., the extrude modifier will not be available on a selection of geometry objects).

The following modifiers are often used with architectural models:

Extrude is used to extrude shapes with option for capping top and bottom of the extruded surface, which applies to closed splines, and with control on the number of segments of the extrusion.

Normal is often used to correct imported meshes unifying the normals of faces not uniformly oriented towards the exterior of the objects, therefore appearing as holes in the surface.

Shell is used to apply thickness to geometry objects. It is important to note that in order to maintain a constant thickness it is necessary to check the option Straighten Corners.

Bevel is used to apply three levels of extrusion to a shape, with an option to offset the source shape at each level.

Bevel Profile uses the selected spline as path for extrusion of a profile which can be picked from a shape present in the scene. Note that the profile shape is used by the modifier as reference, allowing further adjustments, and should not be deleted from the scene.

Sweep is similar to bevel profile but slightly more powerful considering that it comes with parametric and custom sections to be swept along the selected shape. The sweep modifier is often used to generate moldings and structural elements such as steel beams and columns.

Slice, simply slices the object to refine its geometry or to remove portions of it. It is important to note that when slicing objects, in order to render them as solid objects it is necessary to cap the open portions of the object either applying an edit poly modifier or the **Cap Holes Modifier**. The slice modifier is often used to create exploded architectural models to be represented with perspective or axonometric (User) projections.

Noise is used to randomly change the position of an object's vertices along the three local axes. Parameters are available to control the strength and scale of the modifier's effect. Noise is mostly used in architectural visualization to slightly modify the geometry of collections of objects, e.g., natural features such as rocks, vegetation etc...

Displacement is used to modify the geometry of objects using maps (see 6.3).

Edit Spline, this modifier turns any parametric shape into an editable spline leaving the base object parameters available. It is important to note that edits done using the edit spline, as well as the edit poly, modifiers refer to the vertex numbering criteria established in the base object, when the number of subdivisions of the base object is altered, the modifier will still refer to the old numbering and will therefore produce unwanted artifacts.

Edit Poly, similarly to the edit spline modifier, when applied turns the selected object into an editable poly. Using edit poly modifier is usually preferable than just converting as it leaves the option to revert, if necessary, to the source object turning off or deleting the edit poly modifier in the stack. Note that when an object using the edit poly modifier needs to be represented with NURMS, the **MeshSmooth** modifier can be used for this purpose.

4.5 Modeling Walls Using Splines

Interior and exterior walls can be created applying the extrude modifier to 2D splines. Note that the extrude modifier, depending on the orientation of the original creation plane will produce a 3D object in the horizontal (when using elevations) or vertical (when using floor plans) directions, extruding along the thickness or the height of the wall respectively; **exterior walls** with complex openings layout are often generated using splines obtained from elevation drawings, **interior partitions** and vertical structural elements are generated with splines obtained from or created using snaps on imported plans.

5 Populating the Scene with Objects

When working with architectural models it may sometimes result convenient to import into a scene vector drawings such as floor plans and elevations or even 3d models created with other applications. This chapter will introduce to the reader importing procedures and tools used when populating scenes with objects.

5.1 Acquiring Objects from External Files

Importing objects from 3ds Max files is accomplished with the **Merge** command, the corresponding dialog provides the user with a list of objects contained in the file from which the user can select objects to be merged in the current scene, objects will preserve their original world system coordinates. Creating a new file and using Merge to acquire models from an oddly behaving MAX file is also sometimes used to revert to the default scene settings and effectively represents a valid alternative to time consuming scene settings troubleshooting sessions.

Imported drawings are often used as background reference or directly as splines to create geometry objects in the scene. Popular file formats used to import external elements are DWG (the native format of AutoCAD drawings) and DXF (a non-proprietary vector file format). Files can be imported using **Import** or linked using the **File Link Manager** so that they can reflect any progress changes in the source file and be updated in the 3ds Max Scene. The procedure for both importing and linking is similar and the following common variables are usually reviewed:

The **Derive AutoCAD Primitives by** pull down menu of the AutoCAD DWG/DXF Import Options dialog allows selecting the criteria used to derive 3ds Max objects: this includes deriving objects from entity, layer or other properties of the original AutoCAD objects, e.g. when deriving from layer all imported polylines on the same AutoCAD layer will be converted into one compound spline. **Weld Nearby Vertices** is used to close open splines on import. Note that, depending on the distance between vertices to be welded, there could be a noticeable change in the orientation of concurrent segments of the spline since the resulting vertex will be located at the center of the area (or segment in the typical case of only two vertices) defined by the location of all selected vertices within the specified weld threshold. Spline rendering properties can be defined on mass for incoming splines. A list of layers is available to selectively import objects contained in specific AutoCAD layers. It is also important to note that imported AutoCAD blocks are translated into instances, see paragraph 2.3 in regards to Clones.

Popular formats for importing 3d models are ACIS SAT, which is a format used to translate objects from and to solid object based modeling programs, e.g., Autodesk® Inventor, STL, DEM for digital elevation models, WRL often used when importing large 3D models generated with GIS software, OBJ files that are typically used when importing free form curved surface objects from NURBS oriented modeling software, and FBX used with Autodesk® Revit models. Note that when using FBX it is possible to export exploded models as obtained in Autodesk® Revit using section boxes.

It is worth mentioning that when 3ds Max Design models are used for visualization of massing volumetric entities, e. g., Urban Design models, it is possible to establish a work flow that links 3ds Max Geometry Objects to AutoCAD Polylines therefore allowing ramifications enabled by using AutoCAD Fields, Tables and Formulas. This work flow references the splines used in 3ds Max for visualization purposes via the File Link Manager to AutoCAD files, where polylines can be associated to tables with fields and formulas for area calculation.

5.2 Tools and Utilities

Array is a tool used to create one-, two- and three-dimensional arrays of clone objects. Incremental transforms can be applied to clones created with array. The tool's interface allows to control weather the clones will be created as copies, instances or references.

Object Paint, found in the Graphite Modeling Tab, allows distributing clones or MR proxies of an object in the scene with brush settings such as random scatter, rotate and scale. This tool is often used for landscape models, allowing organic distribution of natural features such as rocks, vegetation etc...

Mirror is a tool used to create symmetrical clones of objects. The clones will be placed at the specified Offset Distance. Similar result can be obtained using the **Mirror Modifier** producing one single object where symmetry is applied on sub-object selections.

The **Spacing Tool** (Shift+I) is used to distribute clones of selected objects along splines used as paths. Clones can be arranged on paths using a total number of clones or a spacing value. Start/end path offsets values and fixed or tangential orientation of the clones can be specified.

The **Snapshot Tool** is used to create clones of animated objects at individual or multiple frames with an option to convert clones to mesh objects.

The **Measure Distance Tool** is used to measure the distance between scene features, it is usually used with Snaps on and it reports the resulting value inside the MAXscript Listener (F11). The measure distance tool is used to interrogate the model for quick reference, when the user intends to keep the measurement inside the scene for future reference the Tape Helper Object should be used.

The **Rename Objects Tool** provides a dialog for renaming of multiple objects using prefix, suffix and numbering.

Collapse is a utility that allows attaching a selection of multiple objects obtaining, as a result, one single mesh object. Note that the boolean option is available, often used to remove self-intersecting surfaces that would result by the union of intersecting operands; the main difference with using boolean compound objects is that, with collapse the resulting object, being converted into a mesh, does not allow further editing of the boolean operands.

Measure is a utility that reports the surface area, volume and center of mass of one or a selection of geometry objects and cumulative length of selected shapes. Results can be pinned on a floater window.

Reset X-Form is a utility used to remove all Rotation and Scale values from selected objects pushing those transforms in an XForm modifier and align object pivot points and bounding boxes with the World coordinate system. The XForm modifier can then be deleted or turned off to reset the object's rotate and scale transforms.

The **Numerical Expression Evaluator** (Ctrl+N) is a special control used to invoke a calculator when entering numeric values in any active Numeric Field, e. g., entering values for objects and modifiers parameters, applying transforms, entering values in any tools and utilities dialogs and so on. Note that the hotkey is available only when a numeric field has been activated (left click inside a field). Consult the 3ds Max Design Help File to learn about Expression Techniques that can be used with the expression evaluator.

6 Materials

A palette of materials is crucial for architectural visualization and can be achieved using the compact set of parameters with Arch & Design materials. A library of material templates is also available to provide a solid starting point for subsequent materials creation.

6.1 Material Editor, Material/Map Browser, Material Library

Objects rendered without any material assigned display the wireframe color which does not provide a reliable base for visualization, it is in fact always advisable to assign at least some placeholder material to all objects to be rendered. The material assignment can then be revised during the subsequent stages and finalized for the production of final renderings.

Materials are assigned to selected objects using the appropriate **Assign Material** button on the **Material Editor** (M). The material editor can be used in two modes: Slate and Compact. The slate material editor allows advanced visualization of the material's levels and structure. The compact material editor is a simplified version of the slate material editor. Both modes allow editing the same material's parameters.

Selection of a material for editing is accomplished selecting the corresponding **Sample Slot** in the material editor. Sample slots are rendered views showing the material applied to a sample object. When a material is selected it is possible to adjust its parameters in the dedicated portion of the material editor, the appearance of the material in the material slot is updated in real time. Double clicking on a sample slot will open a standalone re-sizable slot. Solid white triangles at the corners of a sample slot indicate that the material is applied to the selected object in the scene, gray triangles indicate that the material is used in the scene but it is not applied to the selected objects or no objects are selected, lastly, the absence of triangles in the slot indicates that the material is not used in the scene.

The **Get Material** button of the material editor provides access to the **Material/Map Browser** that shows a list of available materials and maps and the **Material/Map Browser Options** button used for opening any **Material Library Files** (.mat) or creating new ones. A number of ready-to-use material library files are included in the installation folder of 3ds Max.

A material used by an object in the scene can be displayed in any slot of the material editor simply using the **Pick Material from Object** button[4].

4 *In recent releases of 3ds Max the former Get Material from Selected Object function can be found under material map browser/ expand scene materials rollout/ right click/ filter selected object.*

Within the material editor it is also possible to save the selected slot's material in the library making it available for future use. **Material Editor Settings** are available such as the number and size of sample slots and using preview objects other than spheres.

The material editor uses a tree structure organization for navigating through specific material's levels. An important interface item used when navigating and editing materials using the Compact Material Editor is the **Go to Parent** button, located on the right side of the material editor's toolbar; when navigating through material's levels, e. g., while editing maps parameters or editing a sub-material of a Multi/Sub-object material, it will be possible to return to the root level of the material using the Go to Parent button, similarly as with any common file browser Up One Folder button.

6.2 Types of Materials

There are two important components of materials: 1) Main Material Parameters: Diffuse and Reflection Levels, used to modify color and reflectivity of the material and 2) General Maps where external bitmaps or procedural maps can be used to override the Diffuse Level of the material and/or surface geometric patterns, see the sub-chapter below in regards to texture mapping.

Even though there are many different types of materials available, in the opinion of the author, knowledge of a few of them will provide a comprehensive palette for architectural visualization:

Arch & Design is a Mental Ray material with simplified parameters and a set of templates, e. g., satin varnished wood, brushed metal and so on. When assigning placeholder materials or when the material specification has not yet been finalized in the project, it is advisable to choose a basic finish template like Matte, Pearl and Glossy from the dedicated pull down menu. Reflection can be controlled setting appropriate values of Reflectivity and Glossines. The **Special Effects** rollout provides control for **Ambient Occlusion**, a shading rendering method that allows to simulate real world light distribution in areas of the model prevented to receive light by surrounding geometry and **Round Corners**, a Material Effect that simulates rounded edges. The **Self-Illumination (Glow)** rollout is used for materials of light-emitting objects, the feature needs to be enabled under Glow Options, **Illuminates the Scene** using Final Gathering (see 8.4).

The **Multi/Sub-object Material** allows multiple materials to be applied to one object using a polygon-based material assignment; polygons of an object can be labeled with different IDs to reference the corresponding sub-material to be used. This type of material works in combination with the Modify Panel's **Polygon:**

Material IDs section, available when editing ePolys or eMeshes at the polygon sub-object level.

The **Blend Material**, similarly to the multi/sub-object material combines two materials, these are blended together using a Mixing Curve formula or a bitmap as a mask. The blend material is often used for tiled surfaces in order to render tiles and grout using two different materials with the Tiles procedural map used as a mask.

AEC Materials is a material library file that includes multi/sub-object materials to be used with AEC Objects (see chapter 2), these materials are specifically compiled in reference to polygons material IDs assignment used by AEC Objects, e. g., the Window parametric object references different materials to be used for the frame, glazing, rails and panels objects components. The AEC Material Library file is located in the folder named “materiallibraries” located in the installation folder of 3ds Max and can be accessed through to the material editor using the material/map browser options button. AEC materials were originally compiled using standard materials as sub-materials, these can be replaced with Mental Ray materials such as Arch & Design.

It is important to note here that, in order to be able to conduct a Lighting Analysis on the model (see 8.5), all objects in the scene need to be using Mental Ray Renderer compatible materials. Using Arch & Design materials, either applied directly onto objects or referenced within multi/sub-object or blend materials, will allow performing Lighting Analysis on the model.

6.3 Texture Mapping

Texture mapping is a method for applying patterns to the surface of objects using Maps. Maps are controlled with the material editor using the General Maps rollout and can also be used to simulate complex geometry and surface geometric patterns on objects when using **Bump** maps and **Displacement** maps. The opacity level of a material can be determined according to the corresponding map's pixels gray scale values using a general **Cutout map**.

Mapping Coordinates are used to control the placement, orientation and scale of maps onto the object's geometry, these are specified using the U, V and W directions respectively used for horizontal, vertical and depth dimensions of the object. Primitive objects have default mapping coordinates. After conversion, editable poly and mesh objects inherit these coordinates but often require further adjustment, this is usually accomplished using the **UVW Map Modifier**. With the UVW Map Modifier the user can control the size of maps and the mapping method (plane, cylindrical spherical and box). Expanding the modifier in the stack it is also possible to select and manipulate the modifier's gizmo to adjust the center of the UVW coordinates. It is important to note that the final scale of the map as represented in viewports and renderings is determined by the combination of parameters set in the material editor under map scale and offset and the UVW map modifier.

Maps can be of two types: **Bitmaps** (JPEG, TIF, Targa Image File, AVI, MOV and MPEG and others, see the help file for a full list of supported file formats) and **Procedural Maps** that are images generated by mathematical algorithms. One noticeable advantage of using procedural maps is that they can usually produce less repetitive textures than using bitmaps. **Tiles** is one of the most popular type of procedural maps; it provides Standard Control of the tiling pattern with preset types and Advanced Controls for the nominal size, number and fade variance of tiles and size of the grout.

Maps can be displayed in viewports using the **Show Shaded Material in Viewport** button found on the material editor's toolbar, this is particularly useful when adjusting UVW coordinates using the UVW map modifier and when tracing on background bitmaps (e. g., raster plans to be used as reference).

The **Unwrap UVW Modifier** is a relatively complex tool, mainly used to assign mapping coordinates to sub-object selections, it is mentioned in this handbook since it provides functionality for unfolding surfaces, a task used in the design of building envelopes. Using the unwrap modifier the user will be able to quickly generate diagrams that can be scaled appropriately and used to make physical models, using 3ds Max geometry as reference.

6.4 Considerations on Reflectance and Transmittance

When working with lighting simulations on architectural models it is crucial to control reflectance and transmittance values of the materials used in the scene as they play an important role in Global Illumination calculations. Values for these two properties of 3ds Max materials are displayed in the material editor and can be fine tuned using the Value parameter in the Diffuse Color Selector (Reflectance) and the Transparency Value in the Refraction section of the material editor (Transmittance).

The reflectance value has a strong impact on the overall decay of the light in an indoor environment and the transmittance is crucial for architectural glass affecting the actual amount of daylight entering through the openings[5].

Typical values used for the reflectance of ground objects are: sand dunes 15-40%, soil dark cultivated 7-10%, grass 20-30%, dry grass 30-35%, woods/bushes 5-20% and asphalt road surface 7-10%.

For architectural glass the transmittance value can be associated with the *Visible*

5 *See in this regard the white paper "Using 3ds Max and Mental Ray for Architectural Visualization"*

Light Transmission Performance Value typically available with the product documentation.

7 Lights and Cameras

A model can not be considered suitable for reliable rendering until materials are applied to all objects and lights are placed in the scene. This chapter will provide information on how to light a scene using both artificial and natural lighting, matching any lighting fixtures layouts and the building's site location and orientation when preparing the scene for the production of photo realistic renderings and lighting analysis.

7.1 Photometric Lights

3ds Max uses Default Lights in the scene for the sole purpose of making objects visible in viewports allowing the user to see a shaded representation of the model while working on it. Default lights are not physically accurate, do not cast shadows in rendered images and are automatically switched off when a light object is created in the scene.

3ds Max provides two types of light objects: Standard Lights and **Photometric Lights**. For architectural visualization it is strongly advised to always use photometric lights that are physically accurate and required for Lighting Analysis (see 8.5). When working with photometric lights it is crucial to maintain a congruent relationship with space dimensions.

Two types of photometric lights can be used to simulate real world artificial lights: **Target Light** and **Free Light**. The only difference between the two being that the orientation of the light object is in the first case determined by the relative position of the light and its target, in the second case by the rotation transforms applied to the object. Both target light and free light come with a list of templates with specific types of bulb and allow using industry-standard photometric files (.IES, .CIBSE, .LTLI file formats) to match the light distribution of specific light fixtures. The light distribution of Target and Free lights can also be defined more generally using Spherical Diffuse casting light in all directions or Uniform Diffuse casting light in one hemisphere only.

The object used to simulate the real world lighting contribution due to the sun and the sky is the **Daylight System** which can be found in the create panel under systems. The daylight system is an assembly that includes two lights, the sky and the sun, and a compass that can be rotated to allow the user to exactly match the project's site orientation. It is important to note that Mental Ray Sky and Sun need to be used when conducting a Lighting Analysis (see 8.5). Location, time and date can be controlled in two ways: using the motion panel or specifying a **Weather Data File**. Both methods lead to reliable results, weather data files (.epw) contain recorded weather conditions for given intervals of time and locations in the world. When using Weather Data Files it is recommended to run Lighting Analysis for a number of days and then average the results to obtain reliable values.

The **Mental Ray Sky Portal** is a light object used in combination with the daylight system to visually improve the distribution of daylight entering through the model's openings. Mental Ray sky portals are therefore placed at all exterior openings in rooms where an interior rendering needs to be produced. It is advised to take advantage of the autogrid option when creating sky portals, this will allow setting the temporary grid parallel to the wall's vertical surface and using snaps to vertex on walls or windows in order to match the exact size and proportions of the opening.

Note that it is not advised to use Mental Ray Sky Portals when conducting a Lighting Analysis on the model as they add an unrealistic direct lighting component to the luminance values recorded at light meters locations (see 8.5).

An important feature of all light objects are **Shadows**, these can be of different types: Raytraced, Area, Map and the Mental Ray version of Area and Map shadows. In general Map shadows render faster than Raytraced but the speed is provided at the cost of accuracy and they do not take into account transparency of materials using general cutout maps. Raytraced shadows are used in most situations (they are also required when conducting Lighting Analysis), the shadow optimization parameter Shadow Ray Bias is used to move the shadow toward or away from the shadow-casting object and the Max Quadtree Depth (default value is 7) can be used to decrease rendering time when set to values between 8 and 10; the default values for both parameters are often accepted.

When populating scenes with lights using Shape/Area shadows as set in the **Emit Light from (Shape)** section of lights parameters in the modify panel, the user needs to be aware that rendering time will be increased with the number of Shadow Samples used, also with this parameter the default value can be often accepted.

Light objects are non-renderable unless the specific option **Light Shape Visible in Rendering** is checked, this option is often used with ceiling lights. When the geometry of the lighting fixture is visible in the scene the component objects of the model of the light fixture are usually grouped together with the corresponding light object so that the entire unit can be moved, rotated and cloned, see 2.3 in regards to Groups.

Light objects are typically used to simulate the distribution of light in a given environment, the Lighting Analysis Assistant can provide the user with calculated luminance data at specific scene locations to be used to assist with further adjustments to the quantity, location and type of lights and to support the design of lighting layouts and other important aspects of a project e. g., fenestration and shading devices.

7.2 Cameras

Cameras are non-renderable objects using similar parameters as real world cameras, except for exposure control that is controlled with the Environment Settings dialog (see 8.2). Two types of cameras are available: Target Camera and Free Camera, the only difference between the two consisting, as already seen with target lights and free lights, in the method used to set the orientation. A camera can be created in the scene as any other object, using the create panel or using the hotkey Ctrl-C on a viewport set on perspective view. The view corresponding to any camera in the scene can be obtained setting the selected viewport to Camera (C). It is always advised to render scenes using cameras rather than viewports set on perspective view.

The suggested work flow for creating cameras is to navigate through the model using the navigation shortcuts presented in chapter 1, in combination with selection of objects and zooming to the extents of selected (Z) – transparent navigation technique also used for the modeling work flow – until a desired view angle is found and the area of interest is adequately represented, the hotkey Ctrl-C will allow the user to create a camera with parameters automatically adjusted to reflect the perspective view obtained navigating the scene. After a camera is created, its parameters can be edited via the modify panel. The most relevant parameters are: **FOV**, used to set the **Field of View** measured in degrees or, alternatively setting the **Lens Size** in millimeters or using Stock Lenses to obtain standard real world lens sizes (note that values of FOV can be adjusted also on perspective views, interactively using the Field-of-View button, or with the Viewport Configuration dialog found under the Views Menu). **Clipping Planes** can be used to limit the representation of the scene, as seen through the camera, to portions comprised between two parallel planes normal to the camera. Multi-Pass effects can be enabled and adjusted for specific cameras such as **Depth of Field**, a gradual decrease of sharpness with the distance from a specified point placed along an axis orthogonal to the lens plane and **Motion Blur**, an effect used with objects in motion to simulate the effect of real world cameras shutter speed.

The **Camera Correction Modifier** can be applied to cameras in order to constrain the plane of representation to be vertical, showing parallel vertical lines, as often required with architectural renderings (parallax). Rather than editing its parameters, this modifier is usually deleted from the stack and applied again when changing location and orientation of a camera.

Cameras can be used for orthographic projections, e. g., elevations and isometric views, using the check box in the modify panel.

Show Safe Frame in Viewport (Shift-F) is used to visualize the boundaries of the final rendered image inside the viewport allowing the user to adjust the coverage of the area of interest, usually accomplished moving the camera's location and/or changing the FOV.

In architectural visualization it is sometimes required to match the camera angle and location of a picture in order to superimpose the project's rendering on the image of the context, e. g., for Landmarks Preservation Commission submissions. The **Camera Match Utility** is used for this purpose; the procedure requires the following steps: loading a bitmap of the picture as a background for the renderer, loading the same bitmap as a background for the viewport, identifying five features (not contained in the same plane) such as context buildings corners that can be identified inside the model, creating five helper objects **Camera Points** to be referenced to the previously identified five features of the bitmap and the last step which is accomplished using the camera match utility, found in the utilities panel, to create the camera with position, orientation and FOV corresponding to the real world camera originally used for the picture. The rendered image is then saved with alpha channel to be used as a layer with image compositing post-production software.

8 Rendering with Mental Ray

The 3ds Max Design built-in rendering engine Mental Ray allows high levels of realism, the time required for the production of renderings depends on the available computational resources, rendering settings, the number of lights present in the scene and geometric complexity of the models (number of polygons). With time and practice the user will develop a sensitivity in regards to objects resolution in relationship to given project requirements and work hours budgets. Important aspects of the production of renderings using Mental Ray Renderer are presented in this chapter.

8.1 Scene Optimization Using Mental Ray

When rendering large scenes with a high number of instances it is advisable to use **Mental Ray Proxies** as this allows memory usage optimization at rendering time. The process of creating Mental Ray proxy objects involves the following steps: creating the source object, creating the Mental Ray proxy object listed under the Mental Ray category of geometry objects in the create panel and then, with the proxy object selected, assigning a **Source Object** using the relative button in the modify panel, note that this last step requires also creating a rendering asset at a desired location on the network using the **Write Object to File** button. Clones can be created from and materials can be assigned to MR Proxy Objects as with any other 3ds Max objects.

8.2 Environment Settings

The **Environment Panel** (8) provides access to rendering background parameters, atmospheric effects and the **Exposure Control** which controls the levels of brightness and contrast of the rendered image. When using Mental Ray as the rendering engine, the **mr Photographic Exposure Control** is advised to be used. This type of exposure control can be adjusted using a single Exposure Value parameter or extended Photographic Exposure control parameters that are similar to those available with real world cameras. A number of presets for the Exposure Value are also available in reference to scene's characteristics such as Physically Based Lighting (scene using Photometric Lights), Indoor/Outdoor and Daylight/Night time. In the same panel, exposure control parameters can be adjusted while a **Render Preview** is updated in real-time.

8.3 Mental Ray Renderer Settings

The Render Setup dialog (F10) allows selecting the rendering engine to be used, adjusting its parameters and define size and proportions of the rendered image. Mental Ray Renderer is recommended to be used at all times.

In regards to renderer parameters, it is important to note that for every increase of quality level and output size inevitably corresponds an increase of rendering time. The following Mental Ray parameters are usually adjusted or reviewed when preparing a scene for the production of renderings:

Global Tuning Parameters are used to set the desired level of precision of Soft Shadows and Glossy Reflections and Refractions. Default values for these parameters are often accepted but can be increased for production renderings.

Sampling Quality defines the type and quality of the antialiasing method to be used, parameters can be adjusted as the minimum and maximum number of Samples per Pixel and the Filter Type used to control the appearance of edges, e. g., Mitchell produces sharp edges, often considered appropriate for architectural visualization. Filter Type Width and Height control the size of the filtered area, increasing these values produces softer edges. The number of samples per pixel has a strong impact on rendering time therefore it is advised to use low values for preview renderings, higher values are usually used for final production renderings. Custom rendering presets can be saved to be restored at any time.

The number of **Reflections/Refractions** to be calculated can be set, these parameters are often used to control rendering time although the default values are often accepted.

Camera Effects such as Motion Blur and Depth of Field (see 7.2) and Contours can be enabled in the Renderer section of the render setup dialog.

8.4 Rendering with Indirect Illumination

Objects in real world are lit by two important components: direct light received directly from the source of light, and indirect light reflected by the surrounding objects and atmosphere. Indirect light should always be taken into account for the production of professional renderings as it allows achieving a better representation of the geometric characteristics of the models. A simulation of this phenomenon is enabled by default when using Mental Ray and it can be adjusted using a number of parameters specifically for Global Illumination, Caustics and Regathering. It is important to note that even though scenes can be rendered with indirect illumination simply using Regathering and adjusting the level of quality using the **FG Precision Preset** slider found in the Render Setup Dialog under Indirect Illumination, Final Gather rollout, the user is encouraged to research and experiment directly with indirect illumination parameters and using diagnostic tools. It is to be mentioned that while using Final Gather presets will require virtually no time for setup while providing acceptable results, better control of final results and rendering time can be achieved, especially on interior scenes, using a combination of Global Illumination and Final Gathering[6].

8.5 Lighting Analysis

The Lighting Analysis Assistant is a dialog used to guide the user through the process of calculating luminance values at specific points in the scene. It is an important tool for designers interested in controlling the amount of natural light and energy related aspects of their projects. Values can be exported to a comma separated values format (CSV) that can be imported into excel-like spreadsheets and used to support submissions of lighting analysis reports required by Authorities Having Jurisdiction[7].

In order to run a lighting analysis the following conditions need to be satisfied in the scene:

1. Final Gather and Raytrace need to be enabled and the Bit Depth of Frame Buffer needs to be set to 32 bit, this value can be adjusted in the Sampling Quality rollout of Mental Ray Renderer tab of the Render Setup dialog.
2. Photometric lights casting shadows need to be used in the scene.
3. With the daylight system only Mental Ray Sky and Sun can be used, the analysis can not be performed using IES or standard sun.
4. Only Mental Ray Compatible Materials can be used in the scene. Suggested materials are Arch & Design and Autodesk® Materials.

Results of the analysis can be overlaid on the rendered image and recorded using **Light Meter** objects placed by the user inside the scene, e. g. at work plane locations, and then exported to CSV files.

Another important requirement that the designer should be aware of when performing lighting analysis is the level of quality of the model's geometry, “light leaks” and artifacts can happen when duplicated edges and polygons are found in the model. As a result of these problems, inaccuracy of lighting analysis results can occur. Good modeling habits and the efficient use of snaps will help the user to produce reliable models for lighting simulations and photo-realistic renderings.

8.6 Non-photorealistic Rendering

Architectural visualization often requires a level of photorealism but there are also situations when using a degree of abstraction becomes a preferable visualization strategy, e. g., early phases of a project when selection of materials is not developed or intended to be emphasized and the production of renderings

6 *See in this regards the paper “Easier Mental Ray Rendering for Design Workflows” by Marion Landry & Pierre-Felix Breton available for download from the Autodesk® website.*

7 *A Video Tutorial for Lighting Analysis is available on line at the following address: www.ferriarch.com/VIDEO/Lighting_Analysis_Tutorial.mp4*

for marketing purposes. The traditional rendering techniques used in these situations are the following: hidden line removal with or without cellular shading – which allows the highest level of abstraction recalling respectively comic book illustrations and traditional architectural line drawings – and composite hidden line removal with photorealistic shading. The above mentioned representational techniques can be achieved using the Mental Ray Contour Shader with parameters located at both the levels of renderer and object's material.

Mental Ray contours can be enabled in the object's material using the material editor's Mental Ray Connection/ Advanced Shaders.

Hidden line removal with Mental Ray is obtained enabling Contours under Render Setup (F10), Renderer tab/ Camera Effects. Default shaders are assigned in regards to the three components Contour Contrast, Contour Store and Contour Output. Relevant parameters[8] are:

Contour Contrast Function Levels parameters: Z Step Threshold, and Angle Step Threshold are used to fine tune edge detection calculation. Parallel surfaces with same material will not produce visible edges unless the distance between the two surfaces is larger than the indicated threshold value. Reducing the value of the threshold increases rendering time and the amount of memory required. Depending on the camera angle, this approach also sometimes produces artifacts on surfaces located at a small angle with the camera. As an alternative, a technique can be used that involves the use of multiple materials. The setup process in this case involves duplicating materials and a new material assignment of problematic object, leading to reliable results.

Contour Store has no parameters.

Contour Output with three options: Contour Composite (used for composite hidden line removal with photorealistic shading), Contour Only (used for hidden line removal without shading) and Contour Post Script (to export contours to a postscript file).

It is important to note here that hidden line removal is performed as a post-production task, edges are derived from rendering's pixels, therefore it is advisable to increase the resolution of the rendered image to increase the quality of the contour lines.

Cellular shading can be obtained in several ways, the most straightforward one being using the Ink 'n Paint material, which can provide also hidden line removal although it is preferable to use MR contour shader for this purpose using Contour Composite for the Contour Output shader.

8 *In order to access the Contour Contrast and Contour Output parameters the user needs to drag and drop “as instance” the button in the render settings into a sample slot of the material editor.*

8.7 Rendering Output

Rendered images can be saved to external graphic files of various common formats, some of these formats (TIF, TARGA and PNG) will support transparency via alpha channel for subsequent image composition. The Output Size of rendered images is defined using the number of pixels. With the use of a simple equation, for a given print size and resolution, the user will be able to calculate the required number of pixels to use in the Render Setup dialog, in the same dialog Standard Output Size Ratios are also available. Time required to render an image is proportional to the total number of pixels to be rendered.

Batch Render is a feature that allows the production of a series of renderings from a list of defined cameras in the scene, automatically saving files of rendered images. **Scene States** can be used when rendering the same scene using different lighting, material assignment and exposure settings.

Network Rendering is a feature that allows using multiple computers as a render farm for rendering animations or individual images, it involves specific network configurations and it is often setup in collaboration with the network administrator.

9 Introduction to MAXScript

MAXScript is the scripting language used within 3ds Max. It allows creation of custom interface elements and execution of routines of commands for tasks that would otherwise result into time consuming and repetitive activity. Routine procedures for project schedules data and vector drawings extraction can be executed with the use of MAXScript.

9.1 MAXScript Tools

The **MAXScript Listener** is a small text box located in the lower portion of the user interface (it can be opened into a larger standalone window via right click) that allows typing statements and executing them selecting the corresponding group of lines and pressing SHIFT+ENTER (or the numeric pad ENTER key). The listener will then return values and any error messages.

The **MacroRecorder** is a tool that, when enabled, will record actions performed by the user and display the corresponding Maxscript statements. It is a powerful tool since it allows the user to visualize the syntax used for specific actions that can be used when writing custom MAXScript files.

MAXScript files are written using the **MAXScript Editor** which is a built-in code editor that provides syntax highlighting and other useful tools and resources.

MAXScript is a complex scripting language, well outside the scope of this handbook, the advanced user is encouraged to research with more specialized sources.

9.2 Example of Data Extraction Using MAXScript

We already learned about object properties in 2.2; in order to gather a list of available properties for a given category of objects, in our case Awning Windows AEC Design Elements, and assuming that one of these objects is present in the scene, we can interrogate 3ds Max using the showProperties function with the following statement via MAXScript Listener:

```
showProperties $AwningWindow001
```

after pressing SHIFT+ENTER the MAXScript Listener will return the following list of object properties:

```
 .height : float
 .width : float
 .depth : float
 .Rail_Width : float
 .Vertical_Frame_Width : float
 .Number_of_Panels : integer
 .Percent_Open : integer
```

```
 .Frame_Thickness : float
 .Generate_Mapping_Coords : boolean
 .Glazing_Thickness : float
 .Horizontal_Frame_Width : float
 .realWorldMapSize : boolean
false
```

the user, based on the information provided and using the following statement, can collect property values for all objects contained in the scene that have the vertical frame width property (in our case the scene contains only two awning windows, AwningWindow001 and AwningWindow002, with vertical frame width respectively of 2” and 2.5”):

```
for o in geometry where hasproperty o "Vertical_Frame_Width" do format
"the frame width of % % is %\n" (classof o) o.name
o.Vertical_Frame_Width
```

MAXScript will return in response the following text:

```
the frame width of AwningWindow001 is 2.0
the frame width of AwningWindow002 is 2.5
OK
```

Results can be exported into an external spreadsheet for further elaboration of a project's window schedule.

Selecting the code in the MAXScript editor and dragging it into a toolbar creates a macro button that can be used to execute the script at any time.

9.3 Available MAXScripts

The following is a list of scripts available online that, in the opinion of the author, are effectively useful for architectural design:

DIMaster by Borislav “Bobo” Petrov – This script implements dimensioning capabilities to 3ds Max Design.

Contour Creator, Optimize Spline, Refine Spline and Fuse n' Weld by Rab Gordon SCRIPTS: MAXScripts that provide tools for generating contour lines from terrain objects and advanced spline editing functions.

deconstructor by Marc Lorenz – This script cuts any object into a number of cubic pieces.

Populate:Terrain by Populate – This script generates terrains from contour lines. In the opinion of the author this terrain utility is by far superior to the built-in terrain compound object.

Neil Blevins's collection SOULBURNSCRIPTS formerly known as BlurScripts.

FerriArch's project “3ds Max as BIM” that implements Building Information Modeling capabilities to 3ds Max.

10 Building Modeling Exercise

10.1 Modeling Walls and Slabs

1. Start a new session of 3ds Max Design set the units to US Standard, Inches and activate Edged Faces on the perspective viewport (F4).
2. Import the file Weissenhof_1stflplan.DWG, select layers A-SILL, A-SLAB and A-WALL.
3. Select the object “Layer:A-WALL” and apply the extrude modifier with value 9', select “Layer:A-SLAB” and extrude by -1', select “Layer:A-SILL” and extrude by 3'.
4. Create a new Arch & Design material, select Matte Finish Template and change the Diffuse Color to white, select all objects (Ctrl-A) and assign material to selected. Your model should look like Illustration 10.1.1

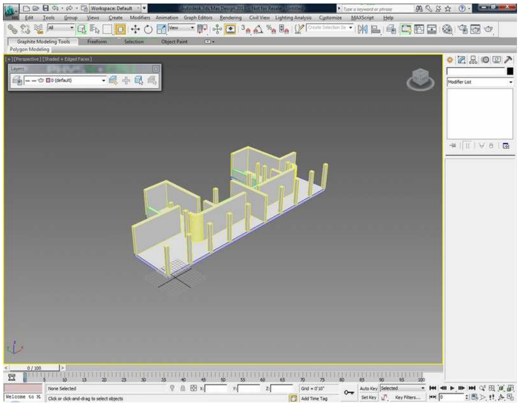

Illustration 10.1.1

5. Select the object “Layer:A-WALL” and Isolate Selection (Alt-Q), apply the Edit Poly modifier, enter the polygon sub-object level, change Window/Crossing on window mode, using the top view select polygons at openings dragging over the entire opening, repeat at all door openings using Ctrl to add to the selection

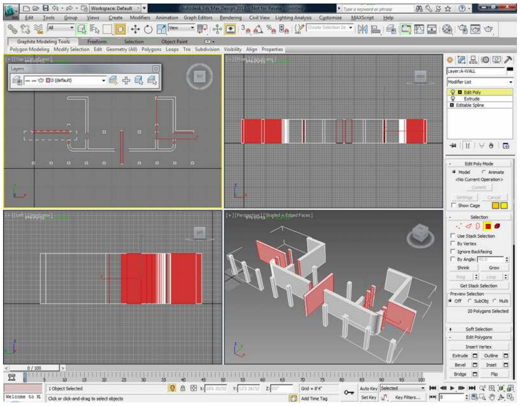

Illustration 10.1.2

use Slice Plane after moving the plane at a height of 6.5'

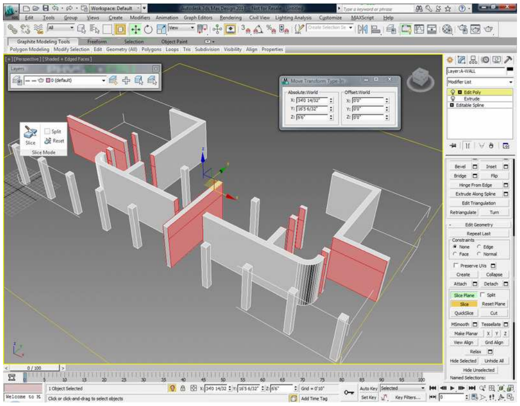
Illustration 10.1.3

set Window/Crossing to crossing mode, using the front view as shown in Illustration 10.1.4deselect (Alt button to remove from the selection) the lower polygons of the walls

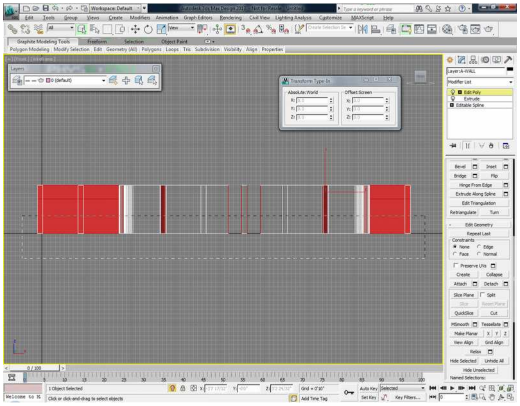
Illustration 10.1.4

cut walls polygons using midpoint snap as shown on Illustration 10.1.5

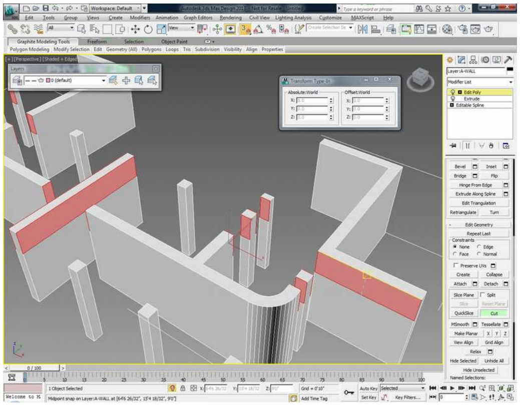
Illustration 10.1.5

switch to edge sub-object level and move the newly created edge using vertex snap and axis constraints as shown on Illustration 10.1.6

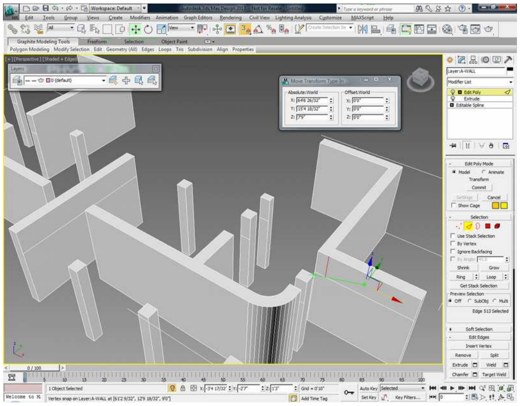

Illustration 10.1.6

deselect polygon as shown in Illustration 10.1.7

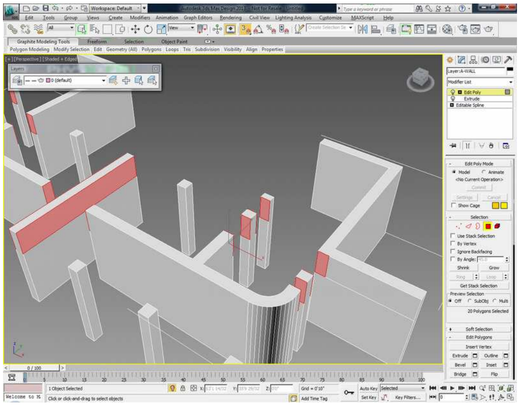

Illustration 10.1.7

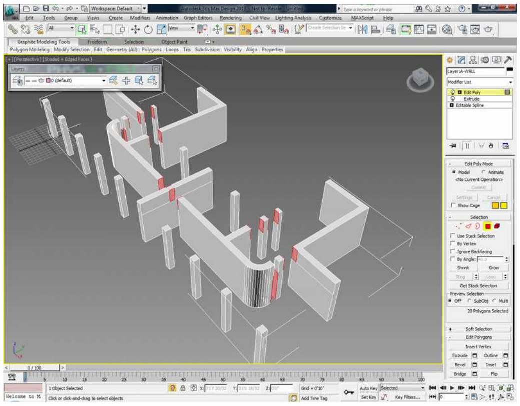

Illustration 10.1.8

repeat at the other 4 locations, invert the selection at two entry doors sidelites and under polygon sub-object level apply bridge to all selected polygons as shown on Illustration 10.1.9

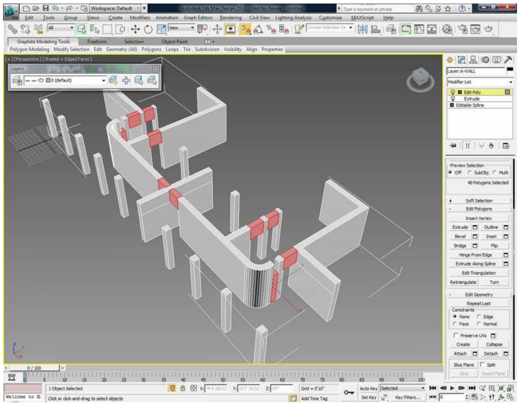
Illustration 10.1.9

under edge sub-object level select and remove (Backspace) all redundant edges

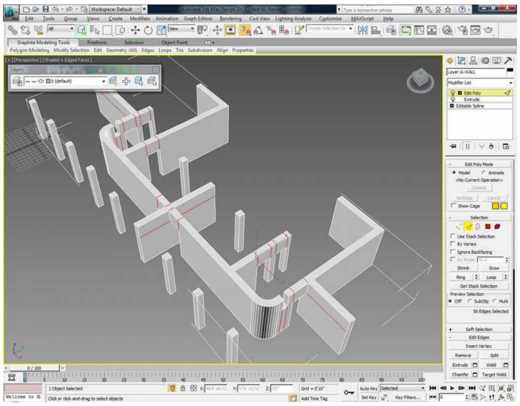
Illustration 10.1.10

check for polygons with shading artifacts and clear all smoothing groups where necessary as shown on Illustration 10.1.11

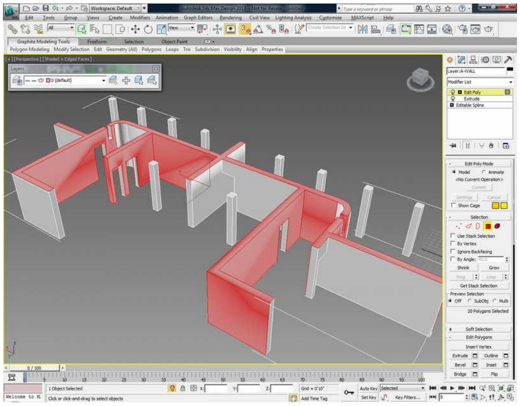

Illustration 10.1.11

under polygon sub-object level move the two sidelites sills -3' on Z Axis, your model should now look like this:

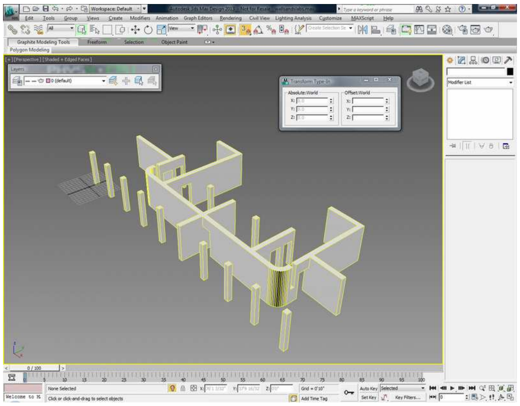

Illustration 10.1.12

exit Isolate Selection (Alt-Q).

6. Using Shift-Move, Snaps and Z-Axis Constraint, clone the object “Layer:A-SILL” as instance

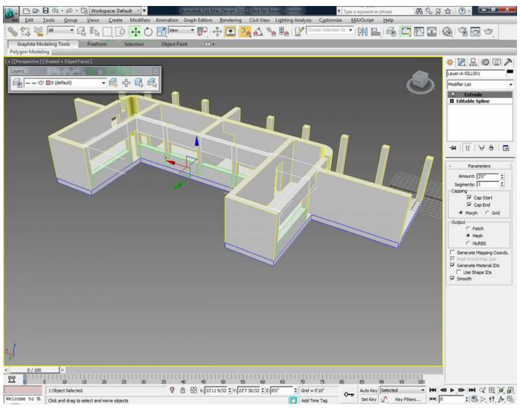

Illustration 10.1.13

7. Select all objects and create a Group as “1STFLOOR”
8. Import the file Weissenhof_2ndflplan.DWG, select the 3 imported objects using Select by Name and move +10' on the Z Axis. Repeat steps 3-6, repeat step 7 but clone the object “Layer:A-SILL” as a copy, apply the Edit Poly modifier to both objects, remove highlighted element from the clone and move the corresponding element from the original object using snap to midpoint of the walls edge so it is placed between the windows as shown in Illustration 10.1.14and Illustration 10.1.15

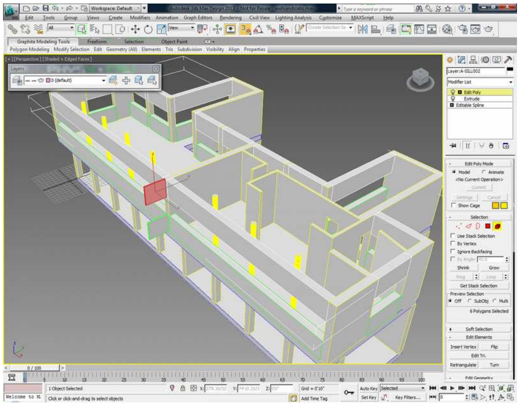

Illustration 10.1.14

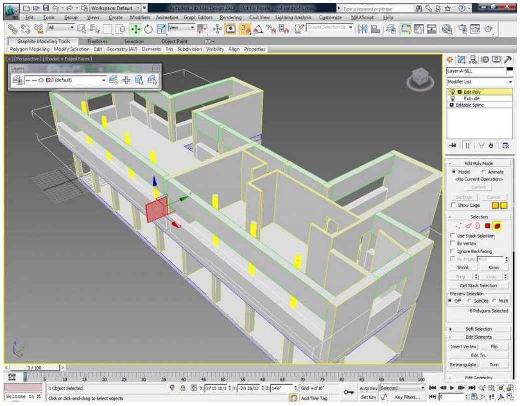

Illustration 10.1.15

Group objects as “2NDFLOOR”.

9. Import Weissenhof_roofplan.DWG, move +20' on Z Axis and extrude walls by 9' and slab by -1', Select the object “Layer:A-SILL”, Isolate Selection and extrude by 3', apply the Edit Poly modifier and modify the geometry using cut polygons and move vertices; extrude polygons by 5' as shown in Illustration 10.1.16, move edges on Z Axis by 6” as shown in Illustration 10.1.17, remove redundant edges, clone elements as shown in Illustration 10.1.18

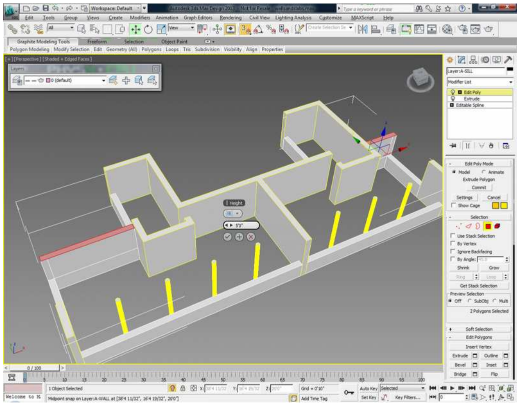

Illustration 10.1.16

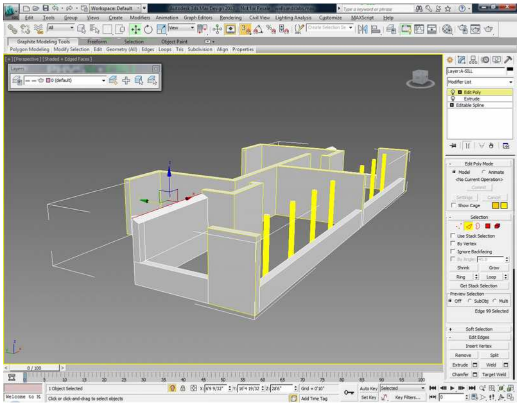

Illustration 10.1.17

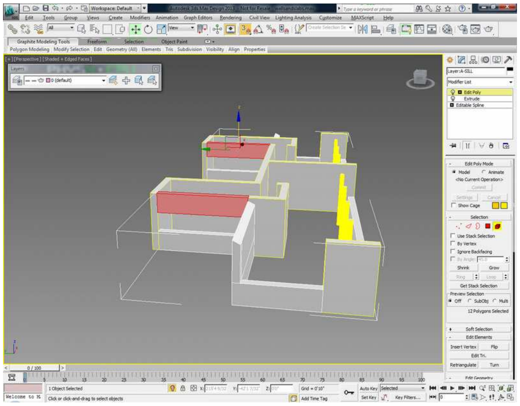

Illustration 10.1.18

10. exit Isolate Selection, select the object “Layer:A-WALL”, under polygon sub-object level select the top polygons

of the columns as shown on Illustration 10.1.19and move them by -1' on the Z Axis

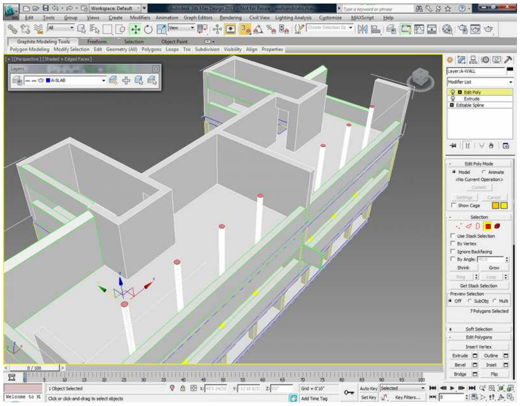

Illustration 10.1.19

create four rectangles on the A_SLAB layer as shown in Illustration 10.1.20

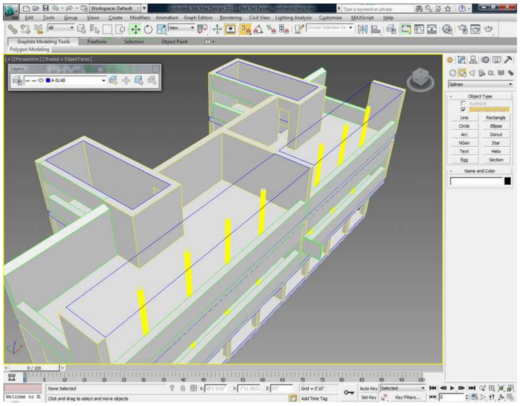

Illustration 10.1.20

extrude all rectangles by -1' and move the two slabs above the stairs by -4” on the Z Axis, assign the same material, group objects as “ROOF”, your model should now look like Illustration 10.1.21

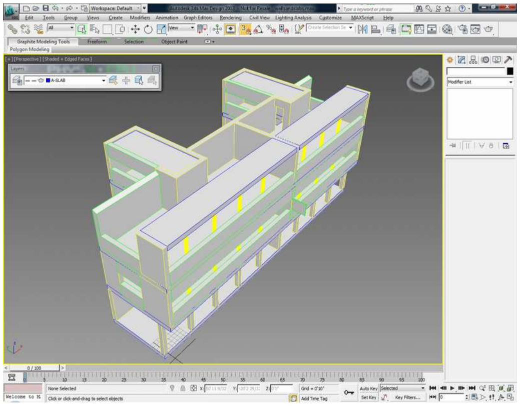

Illustration 10.1.21

10.2 Modeling Doors and Windows

1. Create two new layers: A-GLAZ and A-DOOR and make the A-GLAZ layer active. Select the group FIRST_FLOOR and Isolate Selection (Alt+Q), zoom on the window opening and create a sliding window using vertex and midpoint snaps as shown in Illustration 10.2.1, uncheck the Hung option in the modify panel under Open Window

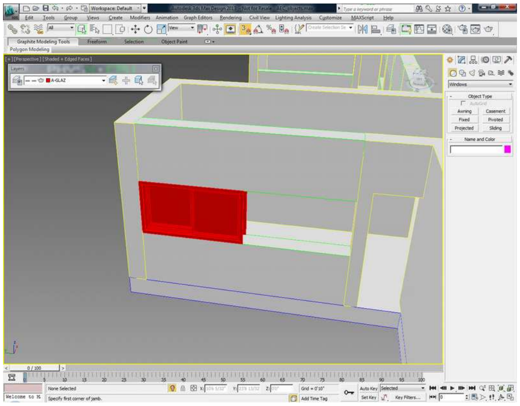

Illustration 10.2.1

clone the window as copy using Shift+Move and snap to vertex, create all remaining windows, use Fixed Windows at entry doors sidelites.

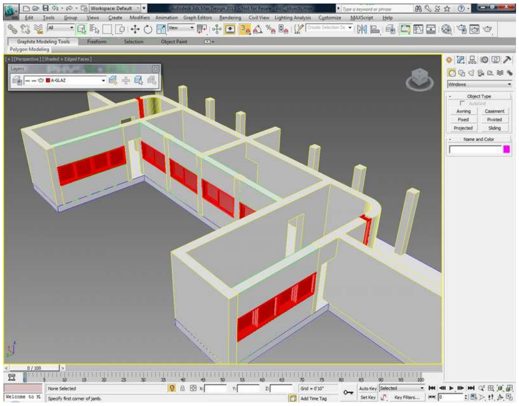

Illustration 10.2.2

2. Make the A-DOOR layer active and create pivot doors at all locations, adjust the Width and Leaf Parameters and move using snap to midpoint to fit the frame in the opening as shown in Illustration 10.2.3

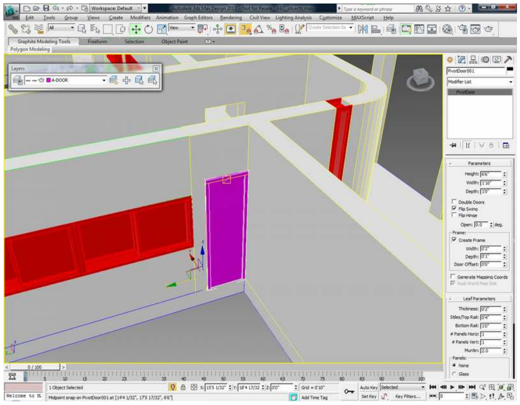

Illustration 10.2.3

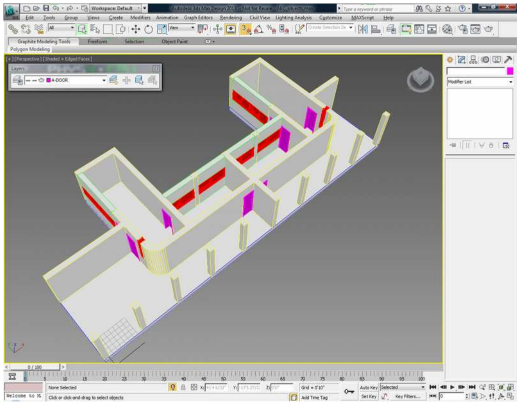

Illustration 10.2.4

3. Using the Layers Toolbar, Select Objects in Current Layer (A-DOOR), change active layer to A-GLAZ and, holding Shift, again Select Objects in Current Layer adding all windows to the current selection, attach selected objects (all doors and windows) to the 1STFLOOR group and exit Isolate Selection.
4. Under Units Setup change temporarily units to Decimal Inches, Select the 2NDFLOOR group and Isolate Selection, zoom to the front elevation and use the Measure Distance tool to measure the width of the front window opening as shown in Illustration 10.2.5

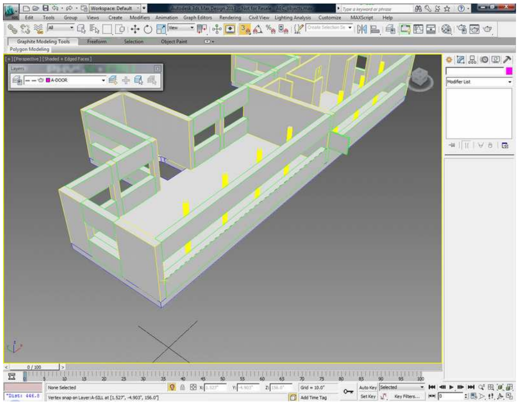

Illustration 10.2.5

open the Listener Window and copy the measured value

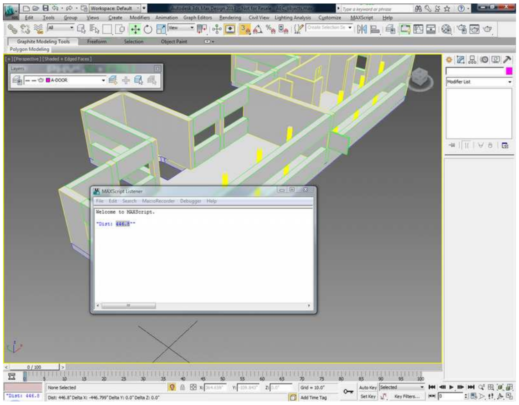

Illustration 10.2.6

create one large window for the entire opening as shown in Illustration 10.2.7

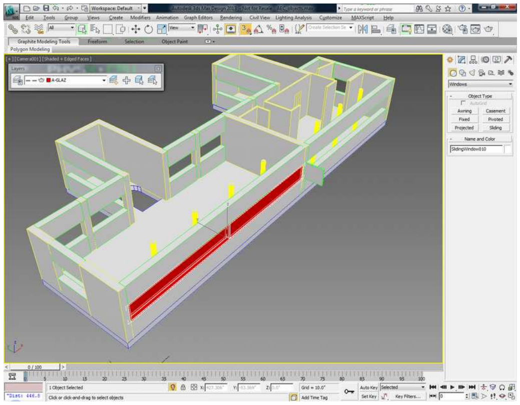

Illustration 10.2.7

edit the Width parameter using the Expression Evaluator (Ctrl+N), pasting the measurement value previously copied divided by 5, move the window on the side of the opening as shown in Illustration 10.2.8 and clone as 4 copies using Shift+Move and snap to vertex as shown in Illustration 10.2.9

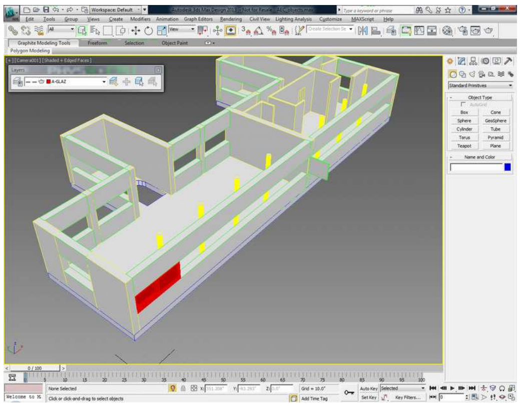

Illustration 10.2.8

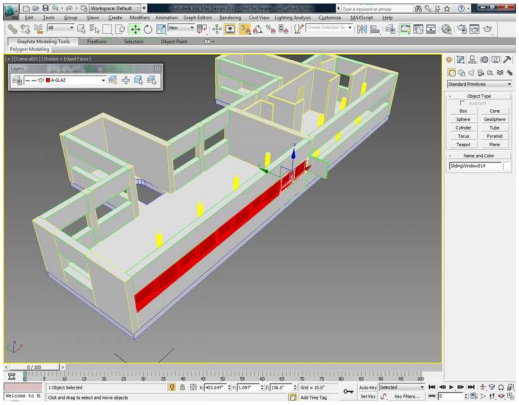

Illustration 10.2.9

5. Complete windows and doors creation as shown in Illustration 10.2.10

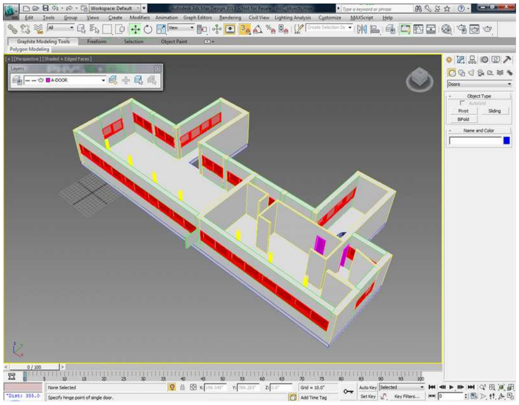

Illustration 10.2.10

6. Attach windows and doors to the 2NDFLOOR group and exit Isolate Selection
7. Similarly as done at the lower floors, complete windows and doors creation at roof level. Your model should now look like Illustration 10.2.11

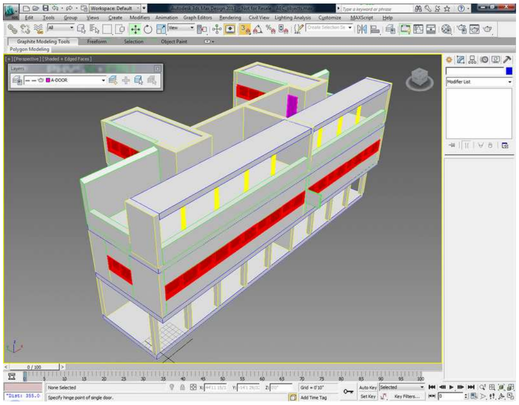

Illustration 10.2.11

8. Create the layer A-STAIR and set it as the active layer. Isolate FIRST and SECOND floors and create a U-Type Stair using snap to vertex, click on vertex number one, drag and release on vertex two then click and release on vertex three and four as shown in Illustration 10.2.12: , Illustration 10.2.13: and Illustration 10.2.14:

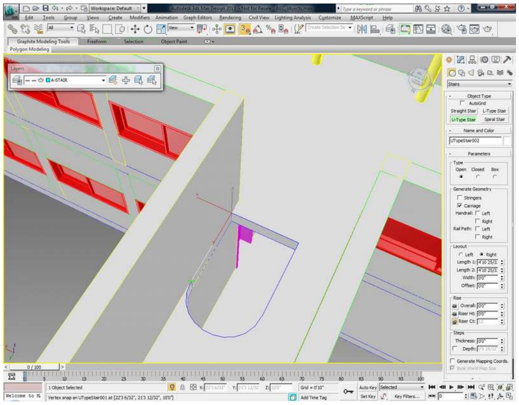

Illustration 10.2.12:

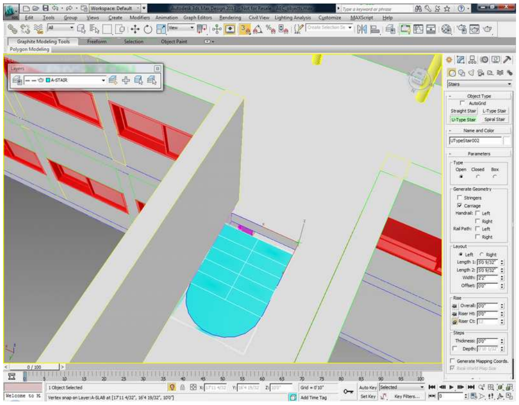

Illustration 10.2.13:

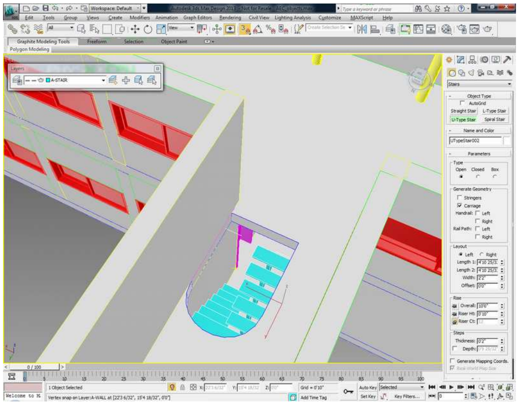

Illustration 10.2.14:

select the stair, unisolate and isolate again, modify the type property of the stair to be Closed and create a Circle using vertex snap as shown in Illustration 10.2.15:

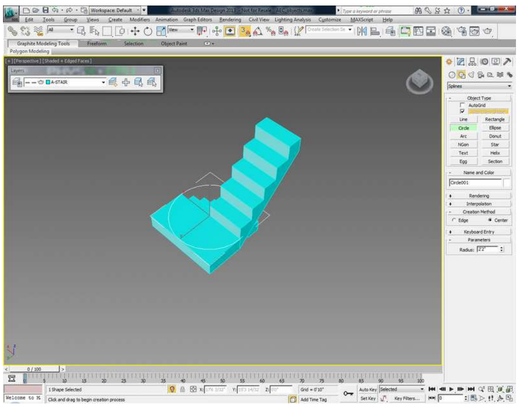

Illustration 10.2.15:

apply Edit Spline and under Edge sub-object level Delete the two Segments as shown in Illustration 10.2.16:

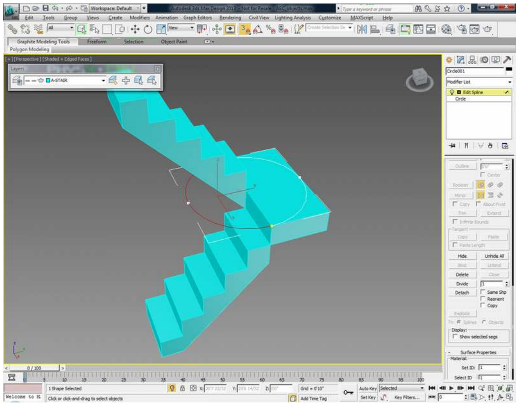

Illustration 10.2.16:

Under Vertex sub-object level Connect the two vertices as shown in Illustration 10.2.17:

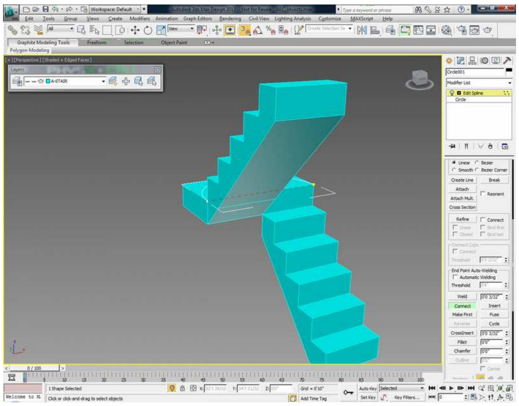

Illustration 10.2.17:

extrude the shape by -10”. Apply Edit Poly to the Stair object and under Element sub-object level Delete the mezzanine and attach the extruded shape as shown in Illustration 10.2.18: and Illustration 10.2.19:

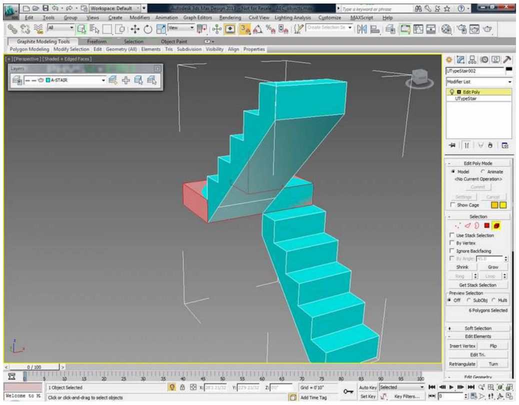

Illustration 10.2.18:

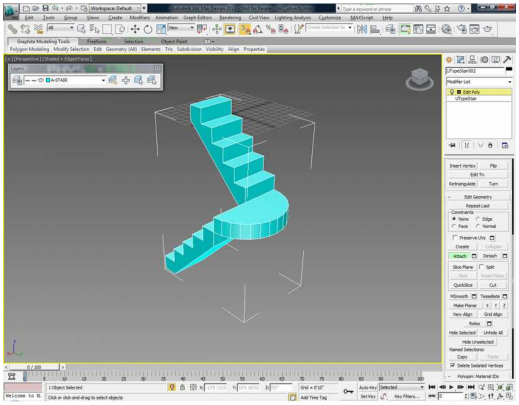

Illustration 10.2.19:

in the modifier stack select the UtypeStair Level and edit the Length 1 parameter to be 5'-11”, under element sub-object level select both ramps and in the top view, using vertex snap move as shown in Illustration 10.2.20:

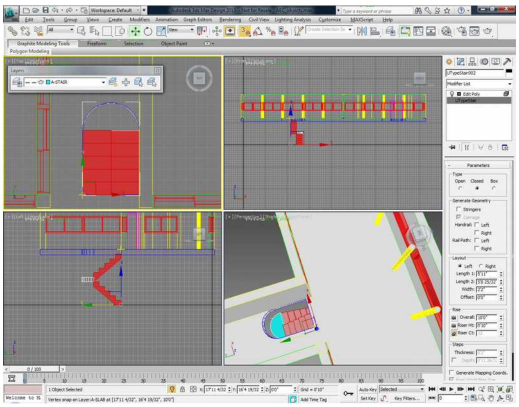

Illustration 10.2.20:

clone the stair as instance at the remaining three locations as shown in Illustration 10.2.21:

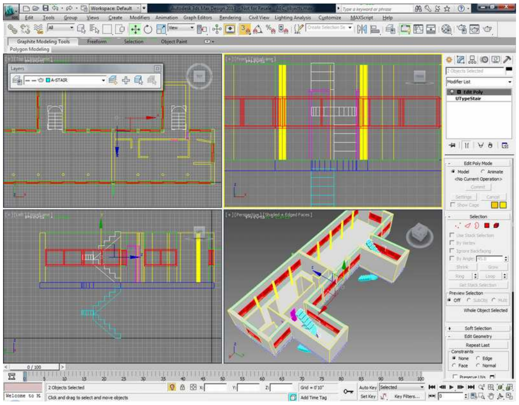

Illustration 10.2.21:

unisolate and, using the Front View, attach the stairs to the groups 1STFLOOR and 2NDFLOOR.

10.3 Materials

1. Open the Material Editor in Compact Mode, select one slot, rename the material to WHITE_PAINT, set the material to be Arch & Design, select Matte Finish Template, edit the Diffuse Color using the following RGB component values: R=G=B=0.85

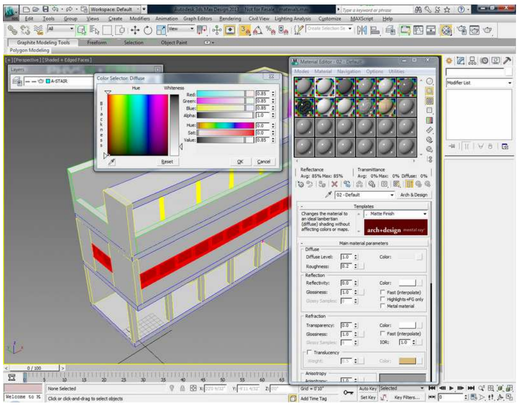

Illustration 10.3.1:

2. Select another slot and set to Multi/Sub-Object and rename to A-SLAB. Drag and drop the slot of WHITE_PAINT into the ID1 Sub-Material button and choose Instance as the Method.
3. Click on the ID2 Sub-Material button, choose Arch & Design, rename to FINISH_FLOOR, select Matte Finish Template, edit the Diffuse Color using the following RGB component values: R=G=B=0.25
4. Using the layers toolbar set the active layer to be A-SLAB, Select Objects in Current Layer, Open Group, Isolate Selection, apply Edit Poly modifier, under polygon sub-object level select all (Ctrl-A) and set the material ID to 1, select all finish floor polygons and set the material ID to 2 as shown in Illustration 10.3.2: , exit sub-object level, assign the A_SLAB layer to selected objects and unisolate.

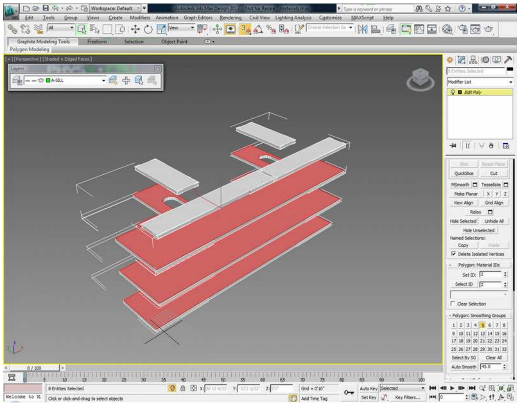

Illustration 10.3.2:

5. Set the active layer as A-WALL and Select Objects in Current Layer, set to A-SILL and, holding Shift Select Objects in Current Layer, set to A-STAIR and holding Shift again Select Objects in Current Layer. Assign the WHITE_PAINT material to Selected.
6. Select the First Floor's Walls, Isolate Selection and, under polygon Sub-Object Level select all polygons and assign Material ID 1, select polygons as shown in Illustration 10.3.3: and assign the Material ID 2, select an unused material slot, rename to 1STFLOOR_WALLS set to Multi/Sub-Object, drag and drop the WHITE_PAINT material slot into the Material ID 1 button using Instance as the method. Set the Material ID 2 to be Arch & Design, Glossy Finish Template, RGB components R=0.26 G=0 B=0 , under Reflection set both Reflectivity and Glossines to 0.4 and the number of Glossy Samples to be 64.

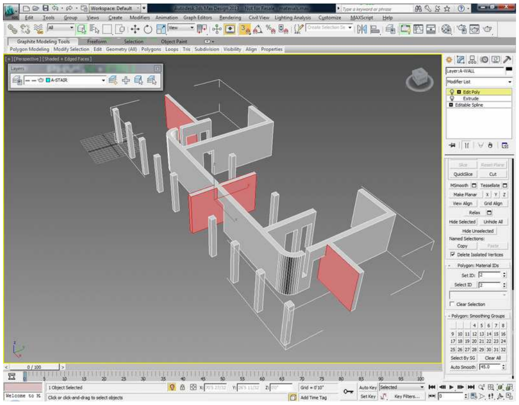

Illustration 10.3.3:

7. Select an unused material slot, using the Material/Map Browser Options, Open Material Library, navigate to the installation folder of 3ds Max Design and import the material library AecTemplates, double click on Door-Template and discard old material. Set the active layer as A-DOOR and Select Objects in Current Layer and assign the Door-Template Material to Selection. Repeat with windows using the Window-Template and close all groups.
8. Edit the Door-Template and Window-Template materials to use Arch & Design Materials as the Sub-Materials. Use Glossy Finish Template and R=G=B=0, under Reflection set both Reflectivity and Glossines to 0.4 and the number of Glossy Samples to be 64 for window frames, and door frames and panels, drag and drop to clone as instance the frame materials as shown in Illustration 10.3.5: . Use Glass (Solid Geometry) Template for the windows glass.

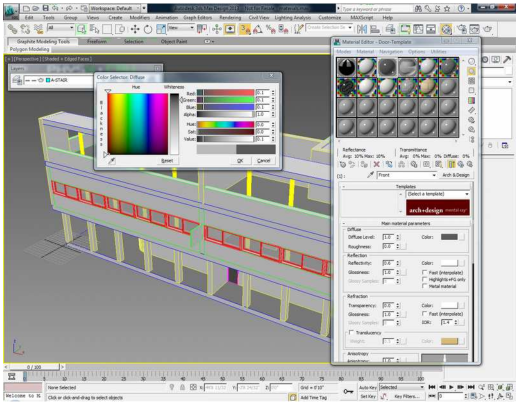

Illustration 10.3.4:

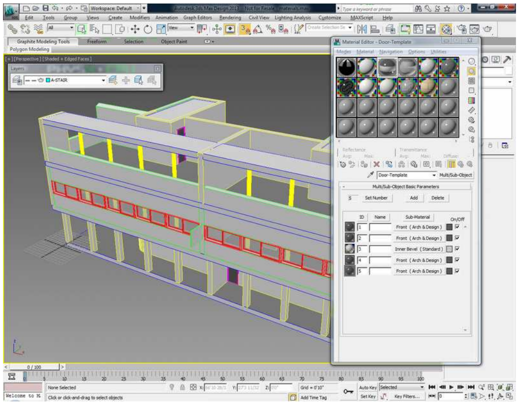

Illustration 10.3.5:

9. Create a new Arch & Design Material, Rename it to COLUMNS, use Glossy Finish Template, RGB components R= 0.024 G= 0.024 B=0.196, under Reflection set both Reflectivity and Glossines to 0.4 and the number of Glossy Samples to be 64. At the Element Sub-Object Level detach all Front columns from the three floors and assign the COLUMNS material to all detached elements. Attach the columns objects to their relative floor group.

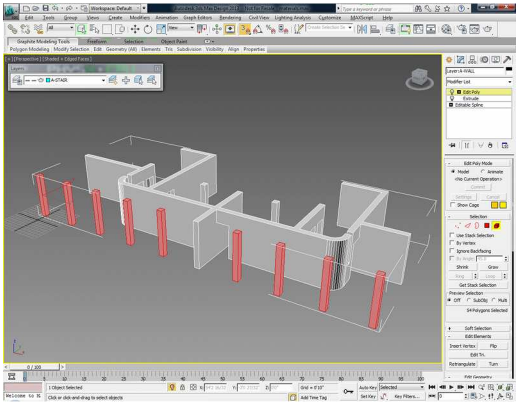

Illustration 10.3.6:

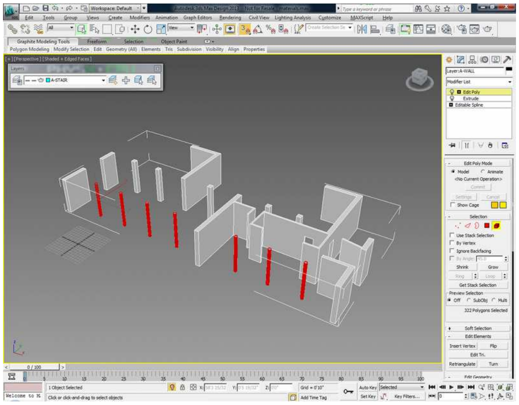

Illustration 10.3.7:

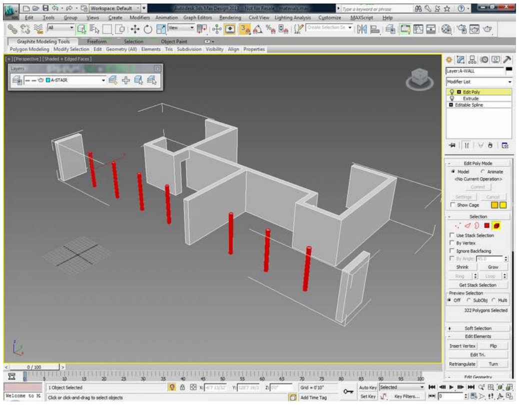

Illustration 10.3.8:

10. Set all Arch & Design Materials used to use, under Special Effects, Ambient Occlusion with 64 samples and 12” Max Distance.

10.4 Cameras, Lighting Setup and Rendering

1. On a Top View, with the 0 Layer active, create a Daylight System as shown in Illustration 10.4.1: accepting all Daylight System Creation and Mental Ray Sky Changes.

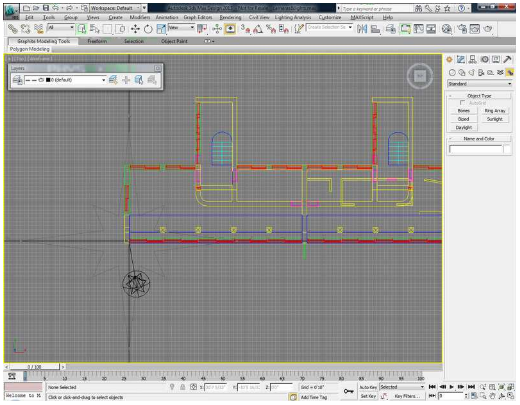

Illustration 10.4.1:

2. With the DaylightAssemblyHead selected, under Position, click on the Setup button and choose to use a Weather Data File, Load the DEU_Munich.108660_IWEC.epw Weather Data File, Select a Time Period at July, 21, 1988; 9:00:00.
3. Select the Compass and rotate -80 degrees around Z the Axis.
4. In Perspective View, set the view to Realistic (Shift+F3), Illuminate with Scene Lights and Shadows.
5. Using Navigation shortcuts set the perspective view to be similar to what shown in Illustration 10.4.2:

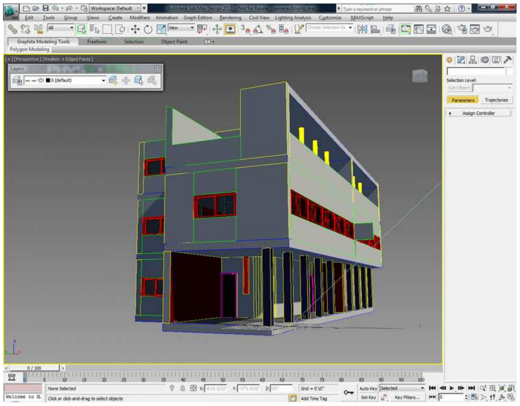

Illustration 10.4.2:

6. Hit Ctrl+A to create a Camera from the view, in Top View right click on the camera and Apply the Camera Correction Modifier.
7. Create a large cylinder with the WHITE_PAINT material under the first floor slab as shown in Illustration 10.4.3: to catch the daylight to be reflected on the building, simulating the ground.

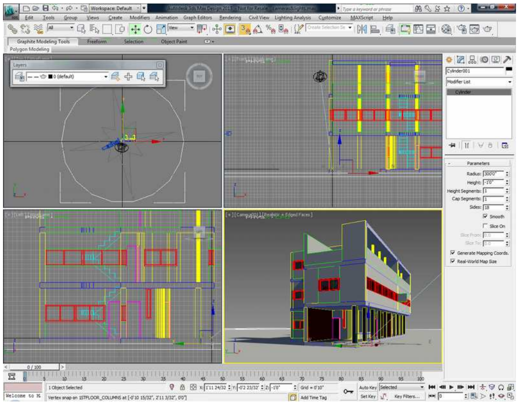

Illustration 10.4.3:

8. In the Rendering Setup Dialog, in the Renderer Panel, set the following Sampling Quality parameter values: Samples per Pixel Minimum =1 and Maximum =16, for Filter Type use Mitchell Width =4 and Height =4. In the Indirect Illumination Panel make sure Final Gathering is enabled and set the following parameter values: Initial FG Point Density =1, Rays per FG Points =500, Diffuse Bounces =2. Finally push the Render button to render a Daylight Simulation of Le Corbusier's House 14&15 at Weissenhoff.

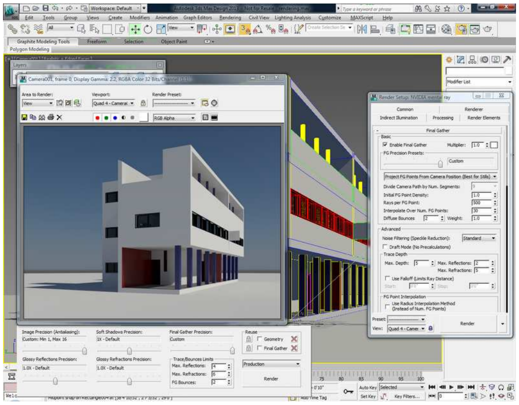

Illustration 10.4.4:

NOTE: A Video Tutorial of this exercise is available on line at the following address:
www.ferriarch.com/VIDEO/Modeling_Tutorial.mp4

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