Design and Animation of A Modern Foundry

Project Report

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CERTIFICATE

This is to Certify that the report titled

DESIGN AND ANIMATION OF A MODERN FOUNDRY

has been submitted by

Mr. / Ms. _____

In partial fulfilment for the award of the degree of

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Guide

Head of the Department

Certified that the candidate was examined by us in the project work Viva-voce held on _____

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SYNOPSIS

In this project, a conventional foundry has been automated and animated. The functioning of the foundry is fully controlled by the machines. The sand is prepared using machines which mix the various additives in right proportion. This sand is sent to the jolting machine which prepares the moulds. These moulds are sent to the furnace via tracks where molten metal is poured into the moulds. Now these moulds are allowed to cool. The moulds are then sent to the knock-out machine which removes the solidified casting. This casting has impurities which is removed by exposing it to stream of lead shots inside the shot blasting chamber. Now the purified casting is sent to the quality control department.

The project follows certain standards that lead to the complete automation of a foundry. The foundry alongwith all the machinery is designed using AutoCAD. The .dxf file of the foundry is then exported to Autodesk 3D studio where the animation is performed.

Contents

INTRODUCTION

A conventional foundry involves a tremendous human labour. All the processes, starting from sand preparation to the polishing of the casting involves humans to a very big extent. As it has always been, humans are prone to commit errors. These errors affect the productivity of the foundry and the quality of the casting. etc.. Hence modernization of the foundry is very much necessary. Here the complete functioning of the foundry is automated by the use of very sophisticated machinery. This, involves less human labour but the productivity and quality are kept high. The various operations carried out in a foundry can be described as follows.

Sand Preparation:

The sand required for the casting is obtained from the mine. This sand is mixed with the various additives to make it consistent. This is now ready for the use in casting.

Jolting and Casting:

The sand prepared is now sent through the conveyors to the jolting machine. This machine is used to prepare the moulding flasks. The flasks thus prepared are sent to the furnace on the tracks. The molten material that

has to be used in the casting is prepared here. This material is poured into the flasks and allowed to cool. After sometime these flasks are put on the knock-out machine where the casting is knocked out of the flasks. The casting thus obtained has unwanted material sticking to it. These are to be removed.

Purification:

The casting thus obtained is put into the shot blasting chamber. Here the casting is exposed to an avalanche of lead shots which completely remove the impurities on the casting. The casting is now ready to be sent to the quality control department.

AUTOCAD

2.1 OVERVIEW OF AUTOCAD

2.1.1 INTRODUCTION

The AutoCAD drafting package is a general purpose computer aided drafting application for your computer . CAD applications are tremendously powerful tools. Autodesk , the developers of AUTOCAD software is the world's leading suppliers of computer aided design and drafting (CADD) software products for desktop computers and workstations . Since its inception in 1982 , the company has introduced a family of products for professionals in a wide range of industries including mechanical design and engineering.

2.1.2 REQUIRED EQUIPMENT'S

In addition to the basic computer system AutoCAD requires a graphics monitor capable of reasonably high resolution for computers based on INTEL 8086 family of microprocessors. An 8087, 80187 or 80287 math co-processor is also required.

2.1.2.1 OPTIONAL REQUIREMENTS:

The above mentioned devices are more than sufficient for the functioning of AutoCAD software. Still, based on the applications it may require additional devices.

There is virtually no limits to the kinds of line drawings you can prepare using AutoCAD. If a drawing can be created by hand it can also be created using AutoCAD. As you draw in AutoCAD, you are creating much more than a drawing. You can place associated objects on layers or group them, forming complex objects that you can operate on as a whole.

No technical or computer knowledge is required to aid AutoCAD effectively. Practice and a thorough understanding of it's features are the keys to proficiency.

2.1.2.1 PEN PLOTTERS AND PRINTER PLOTTERS

Plotters are graphical o/p devices. Plotters are classified as A4, A3, A2, A1, A0 size plotters based on the size of the paper it can handle. Plotters are for plotting CAD applications, architectural drawings. engineering drawings, PCB layouts and other applications. These are used to produce a hard copy of a drawing. Some of these devices can be connected to an RS-232c serial communications port on your computer. Others connect to a parallel output port, and a few require special connections.

2.2.1.2 POINTING DEVICES

A pointing device such as a mouse or a digitizing tablet provides the means for instant command and point entry. Keyboard entry is relatively easy, but pointing at the screen and pushing a button is even easier. In addition in locating points and entering commands, you can use a digitizing tablet to trace over the existing drawings.

2 .1.3 CONCEPTS AND TERMINOLOGY

This section presents some terms and concepts you will encounter while working with AutoCAD.

2.1.4 AUTOCAD DRAWING

An AutoCAD drawing is a file that describes a graphic image. AutoCAD interprets the objects described in the file, draws them on the screen exactly as you would draw them manually .

2.1.4.1 CO-ORDINATES

A cartesian coordinate system is used for locating points in the drawing to position entities. For instance, an X coordinate specifies vertical location. Thus any point on the drawing can be indicated by an X and Y coordinate pair of the form (X,Y). The (0,0) is normally at the lower left corner of the drawing.

2.1.5 DRAWING UNITS

As noted, entities in the drawing are positioned on coordinate points. For example you draw a line by specifying the coordinates of it's two end points. The distance between two points is measured in the units. Thus, a line drawn between the points (1,1) and (1,2) is one unit in length. There is no need to restrict yourself to integers. However AutoCAD's drawing database retains atleast 14 significant digits of precision for each point, so you can place an object at the point (507.316356, 0.00334445) if you like.

A unit can correspond to whatever form of measurement your drawing requires, It can be inches, centimeters, feet whatever. Thus you can draw using real world units and eliminate the possibility of scaling errors. When the drawing is completed you can plot it at whatever scale you like .

2.1.5.1 DISPLAY

The term display has two related meanings. Usually, display refers to the portion of the drawing currently being shown. Occasionally, display means the graphics screen upon which your drawing is shown.

2.1.5.2 ZOOMING AND PANNING

The display can be zoomed in or out to magnify or shrink the visible image of the drawing. When the display is zoomed out, you can see a large portion of the drawing. Zooming in can "blow up" a small portion

of the drawing and show more of it's details. You can zoom in to draw intricate parts of your drawing with exact detail and then "back off" to look at the finished drawing. AutoCAD's zoom ratio is about ten million to one, more than adequate for most applications.

2.1.5.3 WINDOW

The graphics screen is used as a window through which you can look at all parts of the drawing. The coordinates refer to the fixed locations in the drawing and not to the physical location on the screen. Therefore the absolute size of a unit remains constant although the apparent distance between points seem to vary.

Panning allows you to view a different portion of the drawing without changing its magnification.

2.1.5.4 DRAWING LIMITS AND EXTENTS

The drawing limits are the borders of a rectangle . The drawing area is expressed in drawing coordinates . User can select whatever limits to make sense for his drawing. User can change the limits as per his requirements.

The drawing extents specify the actual size at the present time. Imagine a rectangle surrounding all the objects in the drawing the smallest such rectangle defines the drawing extents .

2.1.6 DISPLAY EXTENTS

AutoCAD keeps track of the current screen location by maintaining a set of border called the display extents. These are the borders of the current display expressed in drawing coordinates.. For example, if it is required to display a magnified view of the center of an 8" X 10" PCB the display extents might be

Lower Left corner: (4,3)

Upper Left corner: (6,5)

Zooming and panning change the display extent when they occur. The drawing is regenerated or redrawn to show only the portion bounded by the new extents.

2.1.7 RESOLUTION

Physical resolution refers to the amount of detail that can be represented. The resolution of the display device is specified as "dotsX by dotsY". Higher resolution means a smoother looking display . This affects the work done on the device, not AutoCAD's internal resolution.

While extending the coordinates it is possible to snap them to the nearest point on a grid, which need not be visible. The spacing of he grid points is the snap resolution. It is completely independent of the resolution of the grid points/p or o/p at any time, or turn it off entirely for style drawing.

2.1.9 OBJECTS WITHIN A DRAWING

Objects within a drawing may be simple or complicated. Computer objects can be built using simple construction of rectangular or circular arrays of objects and inception of entire drawing into the current drawing is possible. Different parts of the drawing can be kept in layers.

2.1.9.1 ENTITIES

Entities are predefined elements that can be put into a drawing by means of a single command. Some of the entities are lines, arcs, point, text and polylines.

2.1.9.2 DRAWING INSERTION

This feature treats an existing AutoCAD drawing as a block and merge it into the drawing part and store it so we can keep a library of symbols and components used often in work.

2.1.9.3 COLOURS AND LINE TYPES

Using AutoCAD we can assign a colour or line type to each layer. The colour code varies from 1 to 256. Line type is a specific sequence of alternating line segments and spaces. Standard names have been assigned to the first 7 colour numbers but the actual colours displayed depends on the display device used. The line types are loaded to from libraries and sets the line type for subsequently drawn objects.

2.1.9.4 LAYERS

Using layer is similar to using transparent overlays in drafting. Layers are used to place the entities in your drawing on one or more drawing layers. It is also easy to group associated components of a drawing. This feature helps you control their visibility, color, and line type globally. Layers are perfectly registered with one another. There is no limit to the number of layers in a drawing. A color and line type are assigned to each layer of the drawing and can be assigned to the objects drawn on that layer.

3D STUDIO

3.1 INTRODUCTION

Autodesk 3D Studio is a 3D modeling and animation program for desktop computer. This brings power , versatility, speed and value to the graphics professional to create high quality images or animation's. It has 3D models with which it is possible to create quality spheres , cones and cylinder, spline based lofting process to generate complex objects. It is possible to bring AutoCAD lofting process to generate complex objects. It is possible to bring AutoCAD .dxf and filmroll files into Autodesk 3D Studio.

It provides a built-in materials editor. Materials are created by combining 3 kinds of color settings, transparency control, texture, opacity ,bump, and reflection mapping and special effect .It also provides lights and cameras to obtain a realistic view.

3.2 MINIMUM CONFIGURATION

Autodesk 3D Studio require at a minimum of the following equipment.

* a PC with 80386 or 80486 processor.
* a 4MB RAM
* a Microsoft compatible mouse
* a VGA compatible display board at monitor
* a HDD with a minimum of 20 MB free disk space.

All 80386 based computers require math co-processor which can be an i80387.

(i) CURSOR ICONS

When the mouse is moved around on the desktop , the cursor can appear as six different icons.

a) Around Cursor

When the mouse is outside the drawing area , it appears as an arrow cursor. The arrow cursor is used to choose any command or icon or to activate a viewport . This is the only cursor available in the materials editor.

b) Pick Cursor

The pick cursor selects and places entities in the active viewport. The size of the pick cursor box can be adjusted.

c) Crosshairs

The crosshairs appear when creating geometry. They aid in alignment. The active cursor point is at the intersection of the crosshairs.

d) Multidirectional Cursor

The multidirectional cursor appears during modification operations. Cursor with vertical arrows constraints the geometry to vertical movement.

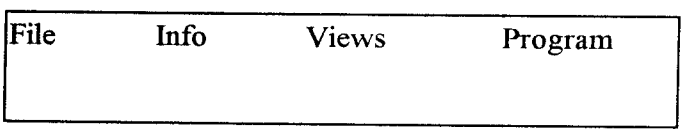
e) Unidirectional Cursor

These cursor appears during bend and taper operations in the 3D editor.

(ii) SCREEN COMPONENTS

a) Status Line

The status line is different in each module but shows mouse cursor coordinates when the cursor is over the active viewport. When cursor is moved into the status line, the pull down menus appear.



Click on a menu title to display a list of options.

b) Viewports

Below the status line are one or more viewports displaying the geometry in memory. Only one viewport can be active at a time.

c) Command Columns

The command columns on the right side of the screen offer all the command specified to the current module.

d) Prompt Line

A prompt line appears in white text at the bottom of the screen.

e) Icon Panel

The icon panel is the array of buttons just below the command column. The buttons control the views in the drawing area.

(iii) EXTENSIONS USED

Each module creates and uses a different kind of native file

* 2D Shaper creates .shp files
* 3D Lofter creates .lft files
* 3D Editor creates .3ds files
* Materials Editor creates .mli files

3.3 MODULES IN 3D STUDIO

3D Studio is an animation package supplied by Autodesk. 3D Studio is composed of five program modules. They are

a) 3D Editor
b) 2D Shaper
c) 3D Lofter
d) Materials Editor
e) Keyframer

Let us describe in detail each of the five program modules.

3.3.1 3D EDITOR

The 3D Editor is the home program module in which you create and arrange the 3D scene for rendering a still image. This scene becomes the first frame of your animation in the Keyframer.

In the 3D Editor, we create, edit, and arrange simple 3D mesh objects, assign materials to the surfaces of objects, add lights and cameras and render the scene. More complex mesh objects can be created by using the 2D Shaper in combination with the 3D Lofter.

Every primitive object is created on construction planes in 3D space. The construction planes are the one's intersecting the two dimensional planes which dictate the placement of created objects. The construction planes intersect at the (0,0,0) origin of 3D space. Many primitive objects can be created. It is possible to adjust the complexity of many of the primitives.

3.3.1.1 3D ORIENTATION

An orthographic view is a 2D projection of a 3D object. The three orthographic views are displayed top(x/z) front(x/y) left(z/y).

The other three possible orthographic views are

Bottom (x/z)

Right (z/y)

Back (x/y)

The user viewport is an isometric view. A 2D projection of the 3D scene as seen from an angle. The construction plane are fixed to the orthographic planes which lie along the three dimension axes (x,y) and z.

The components of a mesh object are elements, faces and vertices. The two isolated sets of vertices are called elements. Every object has atleast one element. Vertices are the points where the corners of the face meet. Mesh geometry is made up of a collection of interconnecting triangular faces. The lines connecting the vertices of each face are called edge.

Edges can be visible or invisible. Invisible edges appear as dotted lines. Autodesk 3D Studio determines at the object creation time whose edges are visible and which are invisible. The face is part of the 3D geometry that reflects light in the rendered image. One side of each face contains what is called the normal. The face normal is a one dimensional vector placed in the centre of each face.

3.3.1.2 3D EDITOR DRAWING AREA

The drawing area is divided into four viewport of equal size. The available views are

* 6 orthographic views
* User view
* Camera view

3.3.1.3 3D EDITOR COMMANDS

The commands are grouped into eight categories

a) Create commands
b) Select commands
c) Modify commands
d) Surface commands
e) Lights commands
f) Cameras
g) Render commands
h) Display commands

a) Create Commands

These help to create 3D primitive such as boxes, cubes, tubes, sphere. These commands helps to alter the shape of an object, increase the complexity of an object, copy or detach faces or elements of an object, perform boolean operations on objects and import flat 2D shapes from the shaper.

b) Select Commands

Select commands creates selection sets of vertices, faces, elements or objects, deselect all currently selected geometry and to select all objects at one time.

c) Modify Commands

Modify commands help to edit objects, delete objects, elements, faces, edges and vertices, display, hide and move the location of the global axis, alter the attributes of an object.

d) Surface Commands

Surface commands help us to assign materials editor to your objects, adjust the smoothing groups for gourad and phong shading, assign texture, opacity and orientation of faces.

e) Light Commands

Light commands help to create omnilights or spotlights, move the position of omnilights, adjust the color of the ambient light, omnilights, rename omnilights and to delete omnilights or shadows.

f)Camera Commands

Camera commands help to create any number of cameras, move the position of cameras, adjust or dolly the camera, rename any camera, set the camera target and to delete any camera.

g) Render Commands

Render commands renders one final scene as a still image, sets up the renderer's parameter and to view image files, animation's from disk.

h) Display Commands

Display commands manipulate the user plane, alter the display of graphics components by hiding and unhiding selected faces, turn on and off the display of lights and cameras and to display and move construction planes.

3.3.2 THE 2D SHAPER

All mesh objects in Autodesk 3D Studio are the result of converting spline polygons which is first created in the 2D shaper. Several polygons can be created in the 2D shaper.

3.3.2.1 2D GEOMETRY

In Autodesk 3D Studio, a polygon is a collection of two or more vertices connected by segments. The lines are the segments. There are two basic types of polygons. Polygon segments may be straight lines or curved. But all the polygons in the 2D Shaper are made up of splines, which can be curved into any form. Each text is made up of splines. All vertices in zigzag line contain linear spline values. Their segments are linear. All vertices in the circle contain perfect values.

3.3.2.2 LOCAL AXIS

Autodesk 3D Studio has a second type of intersection axis called the local axis. The local axis is used when a polygon is rotated scaled or skewed about it's own centre. The local axis is turned on by clicking on the local axis icon.

3.3.2.3 ADJUSTING SEGMENTS

The spline adjustment tools appear in 2D Shaper functions and can be applied to different levels of geometry. The segment adjustment tool adjusts the spline values of the vertices equally on either side of

the selected segment. It is possible to adjust the spline values of all the vertices equally in a polygon using the adjust tool on the polygon branch. The direction of the spline in an open polygon is determined by the order in which you place it's vertices. It is possible to create effective polygon forms by combining two or more simple polygons.

3.3.2.4 GLOBAL AND LOCAL AXES

The axis describes an invisible line along which geometry is moved or about which geometry is rotated or scaled. In the 3D world of 3D Editor, there are 3 axes (x,y,z) representing width, height and depth. In the 2D world of the 2D Shaper, there are only two axes (x,y) representing width and height. The place where the axes intersect is called the global axis. The default appears at the (0,0) coordinate location in the centre of 2D space. The (0,0) location is called the origin.

3.3.2.5 SELECTION SET

Selection set is used to modify more than one graphic component. The first step in creating a selection set is to define the graphic components of the selection set. By using the select option it is possible to select all the polygons in the 2D Shaper. Selection is not confined to whole polygons. When an operation is performed on a selected set of graphic components, the local axis is always at the centre of the selected components.

These are the various options available in the 2D shaper.

The 2D shaper helps to create 3D mesh objects in the 3D lofter, replace the current path with a new path in the 3D lofter, create flat 2D mesh objects in a 3D editor scene, create complex paths for objects, lights and cameras in the keyframer.

Create 2D spline polygons → Import one or more for object creation or one path replacement. If you create one path replacement If you create one object, it is sent to 3D editor and keyframer. → Import one or more as path for objects lights or cameras.

The 2D shaper helps to create and edit 2D spline polygons. Then it is possible to assign one or more of them as a shape. There are four ways in which we can use an assigned shape in 3D studio.

1) Import it into the 3D lofter and loft it along the path in 3D space to make it a mesh object. The program sends the resulting mesh object to the 3D editor and includes in the current scene

2) Use the above to replace the default 3D lofter path which is a straight line.

3) Import it directly into the 3D editor when creating a 3D scene. Use flat objects to cast shadows or to provide a unique background through a process known as texture mapping.

4) Import it directly into the keyframer and assign it to an object as a motion path.

3.3.2.6 CONCEPTS

The concepts of the 2D shaper include

a) Components of shapes

b) Valid and invalid shapes

c) Spline adjustments

d) Curve smoothness

e) The difference between global and local axis

a) Components of shapes

The components are vertex, segment, step, polygon, shape.

b) Valid and Invalid shapes

A valid shape can consist of one or more closed non-intersecting polygons. A nested polygon lies completely within another polygon. A shape consisting of open or intersecting polygon is an invalid shape.

c) Spline Adjustments

Polygons that are created in the 2D shaper are adjustable. BEZIER splines consisting of segments and

vertices. Each vertex in a polygon has a set of direction arrows associated with it.

d) Curve smoothness

Curved segments consist of small straight lines that give the illusion of curvature. Each segment in a polygon is divided by equal no. of steps. More the steps, smoother the curve.

3.3.2.7 LOCAL AND GLOBAL AXES

An axis is a central reference point about which you rotate graphic components. In the 2D shaper, you can use one of the two axes.

* the global axes, which, by default, is positioned at the (0,0) x,y origins of the 2D shaper space.
* the local axis, which is positioned at the centre of the selected graphic component or set of components.,

3.3.2.8 2D SHAPER DRAWING AREA

In the 2D shaper the drawing area uses a 2D cartesian coordinate system. The axes intersect at co-ordinate (0,0) in the centre of the drawing area. The point of intersection is called the origin.

3.3.2.9 STATUS LINE

The status line displays information related to current operation. The status line displays

P:O V:O S:O X : 60.95 Y: 150 : 45

P: Total no. of polygons currently in the 2D shaper.

V: Total no. of vertices in all polygons in the 2D shaper.

S: Current step value

X: Current position of the cursor in the X axes

Y: Current position of the cursor in the Y axes.

3.3.2.10 2D SHAPER COMMANDS

They are grouped into five categories.

a) Create commands

b) Select commands

c) Modify commands

d) Shape commands

e) Display commands

a) Create Commands

Create commands helps to create polygons, copy existing polygons, open or close existing polygons, connect end-vertices and outline existing polygons.

b) Select commands

Select commands help to assign vertices or polygons to section set.

c) Modify commands

Modify commands helps to modify vertices by dragging, rotating, scaling, skewing or deleting, change the spline value of vertices and this alter the curvature, delete individual segments or entire polygons, display, hide or move the location of the global axis.

d) Shape commands

Shape commands help to assign or unassign one or more polygons to or from a shape, display and position shape hooh, define and display the first vertex in an existing polygon, check the validity of a defined shape, adjust the step value of all polygons.

e) Display commands

Display commands help to change and display the first vertex in a polygon view 3D mesh objects residing in a 3D editor and use them as reference background.

3.3.3 THE 3D LOFTER

The 3D lofter converts spline polygons into mesh objects. The spline polygons are created in the 2D shaper placed as cross sections along a spline path in the 3D lofter and converted into a 3D mesh object which appears in the 3D editor. This process of conversion is called lofting.

3.3.3.1 SPLINE POLYGONS AND MESH OBJECTS

Polygons consist of a several collection of vertices and segments. A mesh object is a collection of interconnected vertices and triangular faces in 3D space each vertex can have several segments attached. The segments of polygons are splines made up of a collection of steps which creates curved segments depending on the spline values of the vertices on either side of the segments. Mesh objects contain no steps or

spline values. The lines between their vertices are created by edges of the triangular faces and are always straight. Any curve in a mesh object is the result of the collection of the flat faces arranged in a curve Spline polygons are two dimensional. Mesh objects are three dimensonal. All vertices steps on a path are used as levels. A circle along a straight path can be lofted into a cylinder. The length of the cylinder is the length of the path and the diameter of the cylinder is the diameter of circle shape. The path runs from front to back. Each vertex and each step in the shape creates the edge of a face.

3.3.3.2 SIMPLIFICATION OF MESH

Shape step setting affects the complexity of the objects around the sides. The path step setting affects the complexity of the shape along it's length. When the tween button is active, a cross-section is created for each level of the path which includes its steps. When the tween button of a cross-section is created for each vertex in the path. The areas between the cross-section are called segments.

3.3.3.3 3D LOFTER DRAWING AREA

In the 3D lofter the drawing area is divided into 4 viewports of fixed sizes and location. There are 3 small viewports in the left and a large viewport in the right. The available views are the shape view which is a 2D view of the shape, 6 orthographic views, the user view

or isometric view which displays all 3Ds and deformation grids.

3.3.3.4 STATUS LINE

The status line displays

LVI:3 X :9.64 Z :100.54 Y:87.12[100.00]

LVI: current level on the path

X: current position of the cursor on the X axis.

Z: current position of the cursor on the Z axis.

Y: current position of the cursor on the Y axis.

3.3.3.5 3D LOFTER COMMANDS

The 3D lofter commands are grouped into

a) Shape command

b) Path command

c) Deform command

d) 3D display command

e) Object command

a) Shape Commands

Shape commands helps to input shapes from the 2D shaper or from the disk, sends shapes back to the 2D shaper, copy a shape, tops from any level of the path, delete a shape, change the step value of all the shapes in the 3D lofter and 3D shaper.

b) Path Commands

Helps to replace the current path with a new path by importing an open or used polygon from the 2D shaper, replace the current path, send the current path to the 2D shaper, modify the path by rotating, change step value of path.

c)Deform Commands

Deform commands helps to modify the current module by altering the scale, angle or rotation position of the path. This uses five different deformation grids like scale, twist, teeter, bevel and fit.

d) Display Commands

3D display commands helps to view 3D mesh objects from the 3D lofter and to display manipulate a tape measures icon to measure distances and angles within the active viewport, determine the redraw method for the display of 3D objects.

e) Object Commands

Object commands helps to create 3D mesh object from the current model and to display a preview the mesh object using the current model.

3.3.4 THE MATERIALS EDITOR

In the materials editor we design and edit the materials we assign to mesh objects.

3.3.4.1 DEFINITION

A material is the combination of visual properties that distinguishes one surface from another. Every face must be assigned a material to been by renderer. The properties may be color, texture pattern, reflectivity, roughness or smoothness.

Material editor is used to create new materials or to existing materials.

3.3.4.2 HOW TO ENTER MATERIALS EDITOR

Select materials from the program menu. The screen used by this looks different than that used by the other program modules because it uses the 256 color VGA display whereas the other modules use 16 color 640 X 480 display.

3.3.4.3 SELECTING MATERIAL LIBRARY

The data used by the materials editor is different from that used by the other modules. Here the data describes various material properties. Each material has it's own name and set of properties. All materials are stored in material library which is a DOS file with extension .mli.

3.3.4.2 PROPERTIES

There are 3 basic reflective properties which affect the we perceive its color.

a) Ambient - color reflected by the material in the shadow

b) Diffuse - color reflected in direct light

c) Specular - color reflected directly to your eyes from the highlights of an object.

3.3.4.3 RGB AND HLS

RGB buttons alter the intensity of red, green and blue values of the color. There are 256 possible levels of intensity for each color in the materials editor. The pure mixture of any two colors result in the secondary colors of the light spectrum.

The HLS sliders to the right are excellent for finding a color and adjusting its intensity and saturation.

H stands for hue which represents color.

L stands for luminance which is the intensity of the color.

S stands for saturation which is the purity of the color.

RGB and HLS are simply two ways to describe and adjust colors. Both are interrelated and the sliding of one affects the other.

3.3.4.4 SHADING MODES

Each material is assigned its own shading mode. There are 4 shading modes.

a) Flat

b) Gourad

c) Phong

d) Metal

Flat

Flat mode shades each of the faces on the sphere, but not apply any smoothing across the edges.

Gourad and Phong

The difference lies in the specular highlight. The phong highlight is clear and round while gourad highlight is irregular. These are smooth shading modes.

Metal

This provides the best smoothness for an object.

Transparency

It is possible to control the capacity of transparency of a material with transparency sliders. The materials editor provides a method of simulating this change in transparency. This is called fall off and it is possible to access through f0 button above the transparency slider. Transparency is a subtractive process. Additive transparency adds the material color to the background color.

3.3.4.5 SELF-ILLUMINATED MATERIALS

Self-illuminated materials are not affected by the light sources. The illusion such material creates is self-

illumination. These force the diffuse color value to 100% across the entire geometry. The ambient color value is added to the diffuse. Specular highlights are not affected by self-illuminated materials.

3.3.4.6 MAPS

When bitmap pictures are applied to the material, it is possible to achieve a higher degree of realism and can create the appearance of complex objects using simple geometry. Bitmap is a pattern of pixels which forms an image. When a 3D scene is rendered to a video display, the result is a bitmap. Autodesk Animator Pro is an example of point and animation program that produces bitmaps.

The 4 methods of applying bitmaps to materials are

a) Texture mapping

b) Opacity mapping

c) Reflection mapping

d) Bump mapping

Each mapping method applies a bitmap to the material using its own process.

3.3.5 KEY FRAMER

The Autodesk 3D studio keyframer is the module that analyses the mesh geometry, lights and cameras in your 3D screen and creates a shade picture. Key framer can be used to a series of pictures which when viewed in sequence results in an animation.

3.3.5.1 SMOOTH SHADING

Keeping the mesh geometry as simple as possible speeds up screen, minimizes disk rendering time and disk storage requirements. Metal and Phong shading modes creates the illusion of a smooth surface, though the actual geometry is covered with facets. The smoothness of the object depends partly on the sharpness of the curvature.

3.3.5.2 SHADING MODES

There are 4 shading modes

a) Flat
b) Gourad
c) Phong
d) Metal

Flat is a true shading mode because of the color of each factor shaded based on its angle to one light source and the view. This is not a smooth shading mode.

Gourad is one of the smooth shading modes. This creates gradients of colors based on the location of the vertices of the faces with respect to the light.

Phong is the second best shading mode which produces a realistic effect.

In the metal mode the object has the best smoothness.

3.3.5.3 MAPPING COORDINATES

The materials are nit limited to solid colors. By assigning bitmap images to a material, it is possible to achieve a whole range of effects. Each frame rendered from the keyframer is a bitmap.

3.3.5.4 MATERIAL SHADING MODE

The rendering modes selected from the render still image dialog box are called shading limits because the selected mode sets the limit of the highest shading mode in the rendered scene. In addition to the shading limit set for the scene, each material carries its own shading property.

3.3.5.5 SPOTLIGHTS AND CAST SHADOWS

Omni directional lights spared light equally in all directions from the source. Omni lights are easiest to set and takes least time to render but less controllable. Spot lights can be made to cast shadows.

3.3.5.6 HOTSPOT AND FALLOFF

The edge of the cast pool of light is either blurred or sharp depending on the quality of the flashlight or the adjustment on the followspot. The bright circle in the centre of a blurred pool of light is called the hotspot. The outer extremity of the light, where it meets the darkness is the falloff. If the hotspot and the falloff are of the same size, the pool of light has a sharp edge.

3.3.5.7 CASTING SHADOWS

Casting shadows is a very easy job. The rendering box announces the creation of a shadow map before rendering the scene. Rendering with cast shadows take a longer time. It is possible to have as many spotlights that may cast shadows. Since the time taken for rendering the scene with the cast shadows is more one or two shadow casting is sufficient. The shadows are created by any geometry which blocks the spotlight.

3.3.5.8 DISTANCE CUEING AND FOG

The atmosphere functions add dramatic effects in the 3D scene by applying either distance cueing or fog. Distance influences the atmosphere effects. The first step in using either distance cueing or for is to set the range within which the effect will take place. Fog is similar to distance cueing but for that it adds colored opacity to the atmosphere rather than darkness. The fog definition dialog box is the same as the distance cueing dialog box except that it is possible to set the color of fog.

3.3.5.9 MAPPING TYPES

The 3 types of mapping coordinates are

a) Planar

b) Cylindrical

c) Spherical

They describe the way the bitmap is projected onto the surface of the object or element. A square, green and yellow icon represents the bitmap. The small yellow line at the top of the icon represents the top of the bitmap.

3.3.5.10 MAP PROJECTORS

The 3 mapping icons can be thought of as 3 different types of projectors.

a) Planar projection

This icon projects the bitmap image in a straight line in both directions from the surface of the icon. The bitmap appears to pass through the object.

b)Spherical projection

This icon projects the bitmap from the centre of the spherical icon outward in all directions. The scale or size of the spherical icon has no effect on the mapping.

c) Cylindrical projection

This projects the bitmap from its centre outward 360 degrees to the sides.

Bump Map

Bump maps create an uneven appearance to the surface. The renderer alters its reaction to the face normals. This can be used for rough surfaces like brick or engraved surfaces like the face of a coin.

Reflection Map

These are different from the other map because they do not require mapping coordinates. There are three basic types of reflection map namely :

a) Spherical

b) Cubic

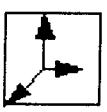
c) Automatic

Thus it is possible to create animation in the keyframer by acquiring a range of frames, the objects, cameras and lights that have been arranged in the 3D editor.

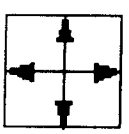
3.3.6 ICON PANEL

Each module in Autodesk 3D studio except the material editor has an icon panel.

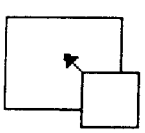
3.3.6.1 2D Shaper Icons



- Axis tripod icon
- Used to adjust the angle of view or to change the active viewport to user view.

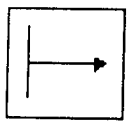


- Pan icon
- Used to move the image with active viewport in any direction.



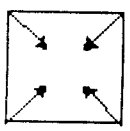
- Full screen toggle icon
- Used to toggle a viewport between normal size and full screen size.

- Local axis icon
- Available in 2D shaper and 3D editor
- Used to activate the local axis.

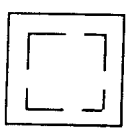


- Switch viewports icon
- Used to switch the view in a small viewport with the view in the large viewport

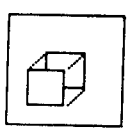
- available in 3D editor.



- Zoom In icon
- Magnifies the active view by 50%

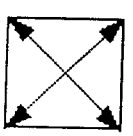


- Window Zoom Icon
- Used to zoom to a defined area.



- Zoom extent icon

- Used to zoom in so that all components are displayed



- Zoom Out icon
- used to display 50% more of the view in the active viewport.

SELECTED -Selected button

TT -Teetor Button

- Used to apply the setting of the teetor deformation grid.

BV - Bevel Button

- Used to apply the setting of the bevel deformation grid.

FIT - Fit Button

- Used to apply the setting of the fit deformation grid.

3.3.6.3 Keyframer Icons

TRACK INFO - Track Info Button

- Used to display track info dialog box to add, delete or adjust the items key.

KEY INFO -Key Info

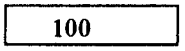
- Used to display key info dialog box.

10 - Segment bar.

- Used to display the active segment in red.

34 - Current frame field.

- Used to indicate the number of the current frame.



-Total frame field.

- Used to set the total number of frame available for fields.

3.3.6.4 Playback Icons

- Click to move to the first frame.

- Click to move back one frame.

- Click to move forward one frame.

- Click to play the animation in a continuous loop.

- Click to move to the last frame.

SYSTEM DESIGN

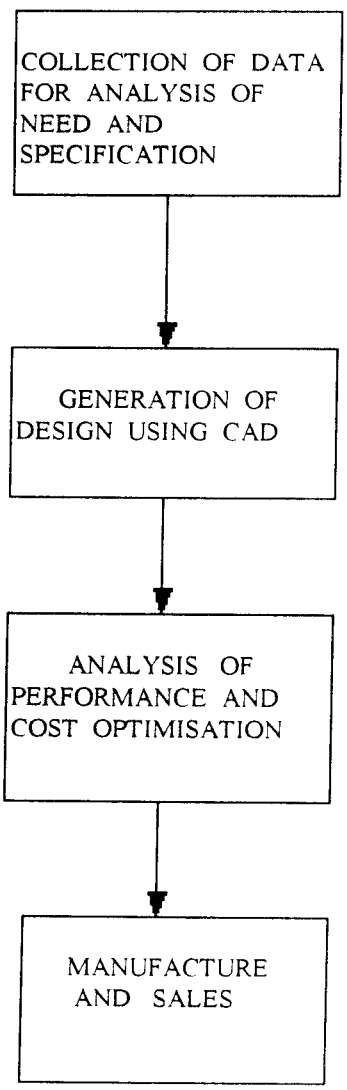
4.1 DESIGN

The foundry and the machinery inside it are designed using Autodesk's AutoCAD. AutoCAD is a comprehensive graphics package. The machines and the various parts of the machinery are drawn on a single layer. All the drawings are drawn using AutoCAD release 12 which has a special feature called Advanced Modeling Extension (AME). This feature is very helpful in drawing 3D objects. For example, the hopper in the jolting machine is drawn as a 2D object which is later extruded to form a 3D object. All the drawings are stored as .dwg file. This file cannot be used to animate. Hence the .dxf file is created using AutoCAD. This file is exported to 3D studio for animation.

4.2 ANIMATION

The animation of the foundry is performed using Autodesk's 3D studio. This is a complete rendering and animation software. The .dxf file from AuotCAD is loaded into 3D editor module. In this module any object can be created , an existing object may be edited, scaled or rendered. This produces a file with .3ds extension. The various objects are assigned materials which are taken from the materials library in the

Block Diagram Of CAD



CONCLUSION

A modern foundry has been designed and animated here. The design phase of the foundry is done using Autodesk's AutoCAD Release 12. The foundry has machines with certain specifications.

A realistic view of the functioning of the automated foundry is obtained by the use of 3D Studio Ver 3.0, which also helps in rendering.

The animation is viewed with the aid of various animation softwares like Animator Pro, AAPLAY and Ani Play.

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AUTOCAD BASIC COMMAND

Apperture target box - controls the size of the object snap

Arc - Draws an arc of any size

Area - computes the area of a polygon or circle.

Array - makes multiple copies of selected objects.

Axis - Display a ruler line.

Blipmode - controls display of maker blips

Block - forms a compound object from a group of entities

Break - erases part of an object

Chamfer - creates chamfer at the intersection of two lines.

change - alters the properties of selected objects

chprop - modify the properties of selected objects

circle - draws a circle of any size.

colour - establishes the color for drawn objects

erase - erases entities from the drawing

explodes - shatters a block

extend - lengthens a line to meet another object.

files - performs disk file utility task

fill - controls the filling of solids

fillet - constructs an arc between two lines arcs or circles

graphscr - flips to the graphics display

grid - displays a grid of dols

hatch - performs pattern filling

help - display a list of command

hide - all hidden lines are removed.

id - displays the coordinates of a specified point

igesin - loads an IGES interchange file

igesout - writes a IGES interchange file

insert - unsort the copy of previously drawn object.

layer - creates named drawing object.

limits - changes the drawing boundaries

line - draws straight lines

list - lists database information for selected objects

load - loads a file of user defined shaper.

ITSCALE - sets scale factor

MEASURE - places marks at specified interval

MINSERT - inserts multiple copies of a block.

MIRROR - reflects designated entities

MOVE - moves designated entities

OFFSET - allows the creation of offset curves

OOPS - restores erased entities

ORTHO - constrains drawing i.e only lines aligned with grid

OSNAP - enables points to be precisely located.

PAN - moves the display window.

PEDIT - permits editing of 2D polylines.

PLINE - draws 2D polylines

PLOT - plots a drawing

point - draws single points

polygon - draws regular polygot

PRPlot - plots a drawing

purge - removes unused blocks

QTEXT - enables text entitices to be identified

QUIT - exits the drawing editor the previous.

REDO - reverses command

redraw - redraws the viewports

redrawall - redraws all viewports

regen - regenerates current viewport

REGENAUTO - controls automatic regeneration

rename - changes the names associated with layers etc.

rotate - rotates existing objects

scale - alters the size of existing objects

select - groups objects into a selection set

setvar - changes the value of system vasriables

SH - allows access to DOScommands

SHELL - allows access to other programs

sketch - permits free hand sketching

snap - helps entities to be placed at a precise location.

solid - draws filled in polygons

status - displays drawing statistics

stretch - allows to move a portion of a drawing

style - creates name text styles.

text - draws text characters of any size

textscr - flips to the text display

time - displays drawing creation and updates times