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VISUALIZATION IN RHINO

Understanding Display Modes



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Contents

Chapter 01

Camera

- 08 Overview
- 09 Camera Setup
- 10 View Properties
- 13 Focal Blur
- 14 Safe Frame

Chapter 02

Display Modes

- 16 Overview
- 18 Management
- 19 General Settings
- 26 Grid Settings
- 28 Objects Settings
- 44 Shadows Settings
- 50 Other Settings

Chapter 03

Rendering

- 52 Overview
- 56 Light settings
- 57 Material settings
- 60 Environment settings
- 61 Ground plane settings

Chapter 04

Render Settings

- 62 Overview
- 63 General settings
- 64 Resolution and quality
- 64 Backdrop settings
- 66 Lighting settings
- 68 Wireframe settings
- 68 Extended settings
- 69 Effects

Chapter 05

Raytracing

- 70 Overview
- 71 General settings

Chapter 06

Stylized Product Visualiztation

- 72 Overview
- 73 Scene Organization
- 73 Camera Setup
- 74 Display Mode Setup
- 78 Coloring
- 78 Rendering

Chapter 07

Stylized Architecture Visualization

- 80 Overview
- 81 Scene Organization
- 81 Camera Setup
- 82 Display Mode Setup
- 85 Material Creation
- 85 Rendering

Chapter 08

Styles

- 88 Overview
- 90 Style A
- 92 Style B
- 94 Style C
- 96 Style D
- 98 Style E
- 100 Style F
- 102 Style G
- 104 Style H
- 106 Style I
- 108 Style J
- 110 Style K

Chapter 09

Sources

Preface

About This Book

Design representations indicate into two directions, to the inside of their authors and to some exterior. In the former case, it is similar as Heinrich von Kleist [\[0\]](#) described it in the early 19th century, in his famous essay about the gradual solidification of one's own thoughts, while arguing to an arbitrary someone, or, to put it more popular: How could I know what I think, before I hear what I am saying.

For designers, the language of their speech is drawing. In the most primary scenario, they are both instances, the ones, which are creating the drawings and, at the same time, the ones, who are addressed by those. In this way, designers imagine a future that yet does not exist. They externalize and re - present their own, maybe vague ideas to themselves, thereby concretising, reflecting, arguing, rejecting, putting them aside, or carrying them further. At its core, this process is a private one, with its very own, particular rhythm. It is about thinking by the hand, as Otl Aicher described it beautifully in 1991 [\[1\]](#), among other reflections and speculations about the relation of the analogue and the digital, as a part of his philosophy of making.

But this privacy can open up into the public and invite others, as for instance Yona Friedmanns vivid, powerful, in some way mysteriously appearing drawings. They do not make obvious, whether they are private reflections, or part of a chroniclers archive of a future that has already vanished, proposals for an upcoming new architecture, or something else. This ambiguity is exactly what invites us to create our own imaginations, to use our own fantasy, as Friedmann claims himself [\[2\]](#), addressing young architects.

The latter of the above mentioned categories, where design representations are directed to the outside, to some audience, not being part of an ongoing design process but showing something, which is already well developed, can have a similar quality. The architecture and masterplan paintings and drawings of Balkrishna Doshi give a wonderful example. Their peculiarities become apparent at first sight. The colours seem to be unusual, at least for a western aesthetic socialisation. One single image shows buildings from the inside and from the outside simultaneously. Side views are folded into top views and combined with isometry and different projections, hence presenting the architecture beyond our usual perception in a complexity,

Both examples refer to analogue representation techniques. It is questionable, whether digital means will contribute significantly to an immediate, intuitive design process in the nearby future. Their bulky binary logic, camouflaged behind more or less fancy interfaces, still creates lots of delays and erects cognitive obstacles between the designers and their imaginations. Of course, the algorithmic nature of computational design is a great and valuable source for inspiring designs. But the analogue sketch is still the realm of ideas, concepts and imaginations.

that demands involvement to unveil the depicted.

This is definitely different, when it comes to images, which shall explain aspects of designs to others. Digital representations have become the prevailing media, and not always only for the good, what can be easily verified by just looking for renderings of any kind of design subject by some engines image search. What faces us are many, very many pseudo-photorealistic images with little or no intentional abstraction at all. We look at something, that does not exist yet, but we are already excluded. No vagueness, no mystery, nothing left open. We are neither invited to be part of the design process, nor is our fantasy inspired. Image instead of imagination, and more photorealism does not make things better.

This, slightly exaggerated observation was the initial seed of our concept for teaching and learning rhino representations. We invite you to learn and explore representation techniques, that desire abstractions and may develop in both directions, into creating images that are descriptive and are making curious at the same time, and thus, help to clarify and communicate own design intention to our selves and to others.

Technically, our examples are mainly based on the Rhinoceros (version 7.x) preview options, with little or no rendering at all involved. We wanted to achieve as much variability in expression with as little efforts in mastering tools as possible. The teaching material starts by giving a comprehensive introduction into the required instrumental knowledge. Then it explains in detail how to create two quite different representation styles. Condensed profiles of roughly a dozen other styles follow, ready to be implemented by yourself.

This project was kindly supported by digiLL [3], a university network that promotes digital education. Additional teaching and learning resources are accessible from there, and as well from the food4Rhino platform [4]. Special thanks go to Gabriel Rumpf and Max Stein who, despite their modest salaries, did the main work on this project and provided their extensive technical expertise, an above-average high level of commitment and an always open ear for our conceptual ideas over months. This made the collaboration a pleasure and motivates us to continue.

Tom Philipps, Markus Schein

[0] https://de.wikisource.org/wiki/Ueber_die_allm%C3%A4hliche_Verfertigung_der_Gedanken_beim_Reden. (Last visit: 21-01-23)

[1] Otl Aicher (1991): analog und digital. Ernst & Söhne, Berlin.

[2] https://www.dbz.de/artikel/dbz_Nutzen_Sie_Ihre_Fantasie___3283757.html (Last visit: 21-01-23)

[3] <https://digiLL.de/>

[4] <https://www.food4rhino.com/>

Chapter 01

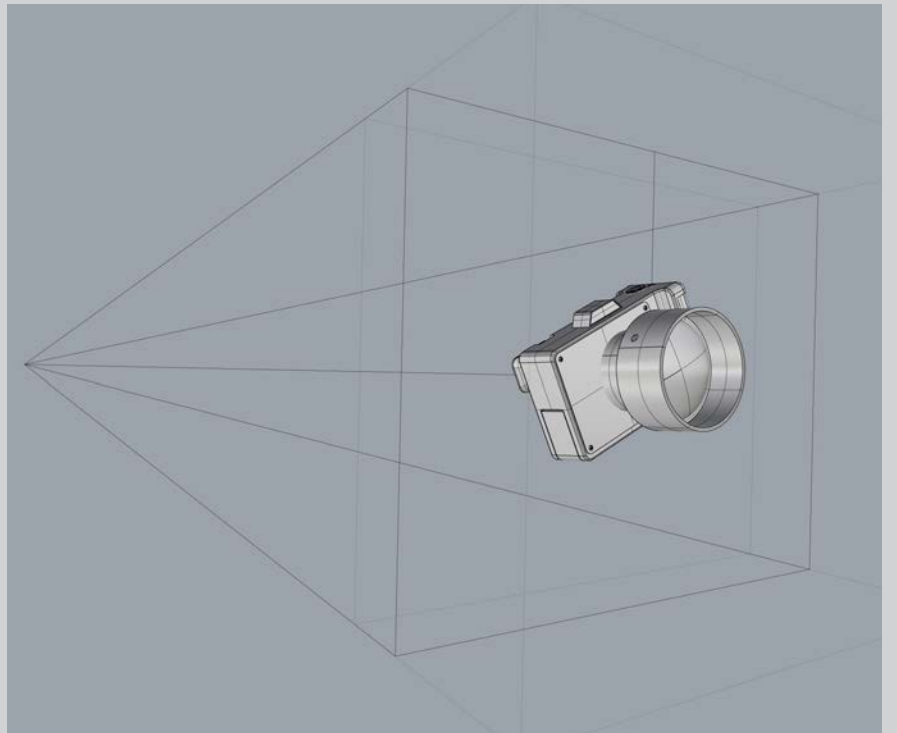
- 01 Overview
- 02 Camera Setup
- 03 View Properties
- 04 Focal Blur
- 05 Safe Frame

01 // Overview

Cameras in Rhino

Since the camera placement is the first step for any stunning visualization, in this first section of the book, we'll explore how virtual cameras work in rhino. We'll take a look at all the options Rhino offers to configure views and how to save and store them for later use.

01



02 // Camera Setup

02

Through out this chapter, we will use the term "view" synonymously to "camera". To setup a camera in Rhino, we can first simply adjust the perspective inside the rhino viewport by rotating and moving our view. Note, that the camera can easily be focused on an object by selecting the target geometry and using the "zoom slected" command from the standard ui tab (Fig. 02).

Named Views

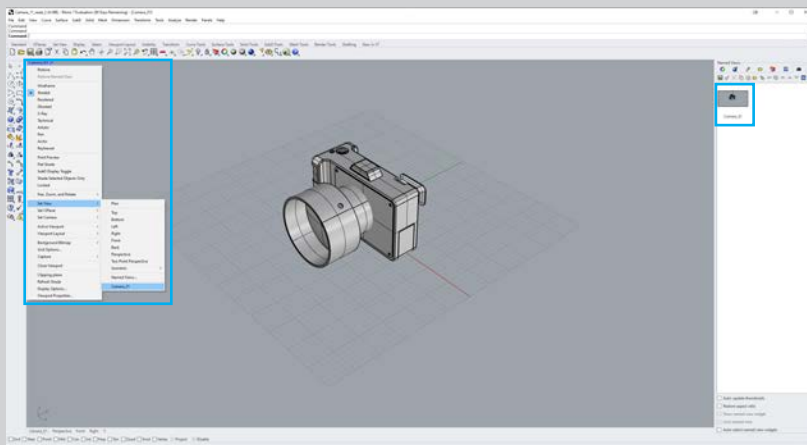
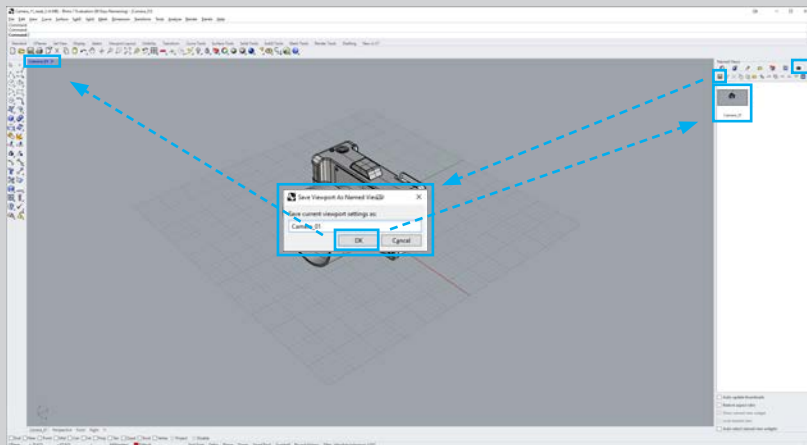
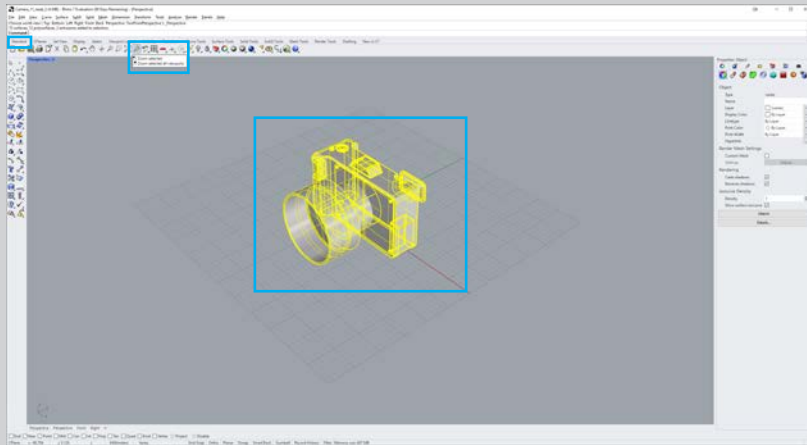
03

To save and load the camera position and orientation, we can use the "Named Views" tab. In case the "Named Views" tab is not shown, it can be added by clicking on the gear icon to the right of the panel menu and selecting "Named Views".

To save the current camera view, one can simply press the "save" icon in the "Named Views" tab. A new window will open that will let us choose a name for the camera setup. After confirming the title by pressing the "OK" button, a preview image of our named camera view will appear under the "Named Views" tab and the view of our viewport will be automatically changed to the camera we just created (Fig. 03).

04

To switch between different views, we can either choose them from the viewport menu or by double-clicking on the preview images in the "Named Views" panel (Fig. 04).



01 Camera

03 // View Properties

The view properties offer additional options to configure the view of our camera. The "viewport properties" panel will automatically be displayed in the "properties" tab of the panels menu if no object is selected. In case the properties tab is not shown, it can be added by clicking on the gear icon to the right of the panel menu and selecting "properties" (Fig. 05, 06).

Viewport Settings

Display Modes can be applied in two different ways.

A. Title

Defines the name of the current view. The default view will be the Perspective view. Note that the title of your current view is also displayed in the top left corner of the rhino viewport.

B. Width

Defines the width of the view. This value is bound to the selected viewport width dimension and will automatically adjust.

C. Height

Defines the height of the view. This value is bound to the selected viewport height dimension and will automatically adjust.

D. Projection

Defines the projection type of the view (Fig. 07).

a. Perspective

Regular perspective projection.

b. Parallel

Parallel projection. Can be used to achieve an isometric perspective.

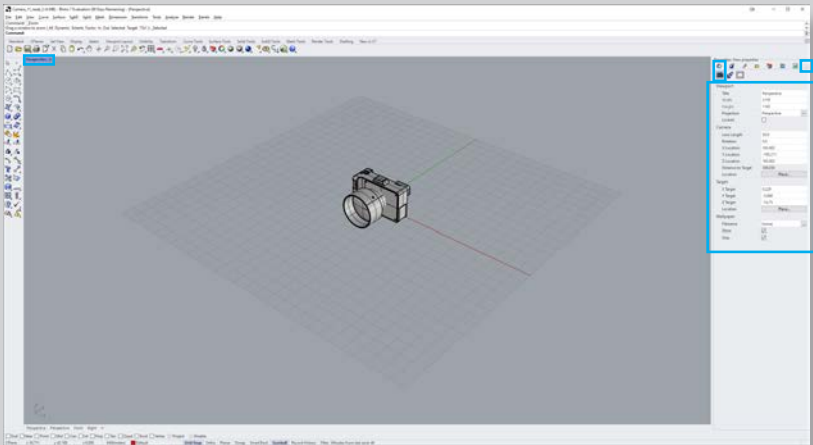
c. Two-Point Perspective Projection

Two-point perspective projection.

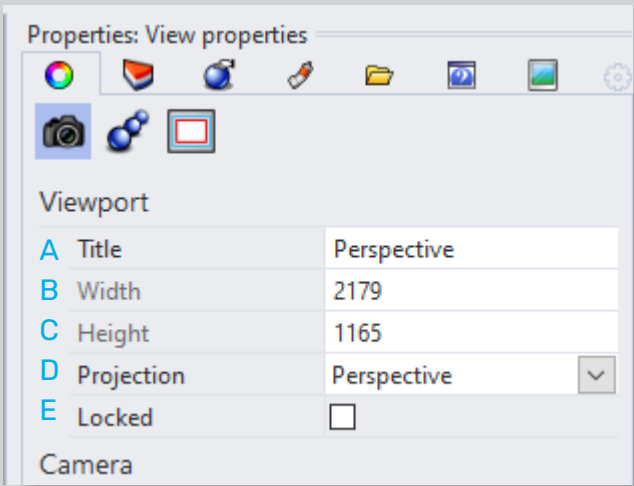
E. Locked

If this option is turned on, the view is locked and cannot be rotated or moved.

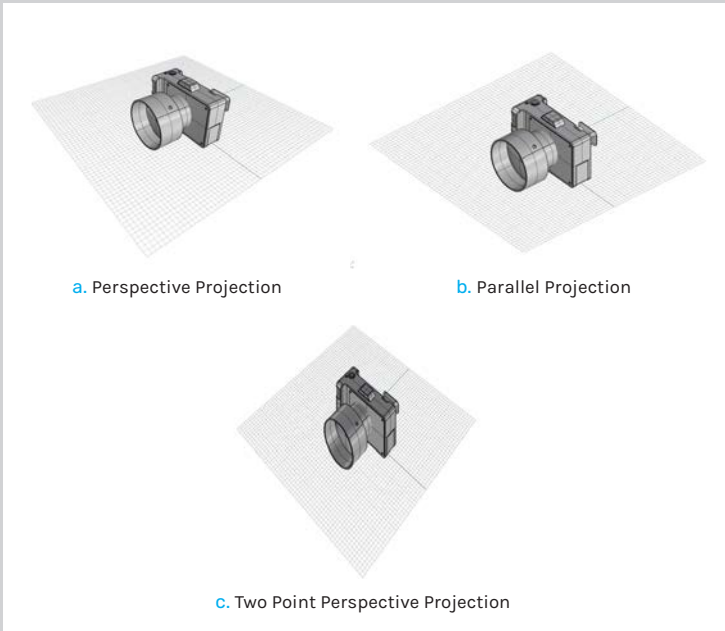
05



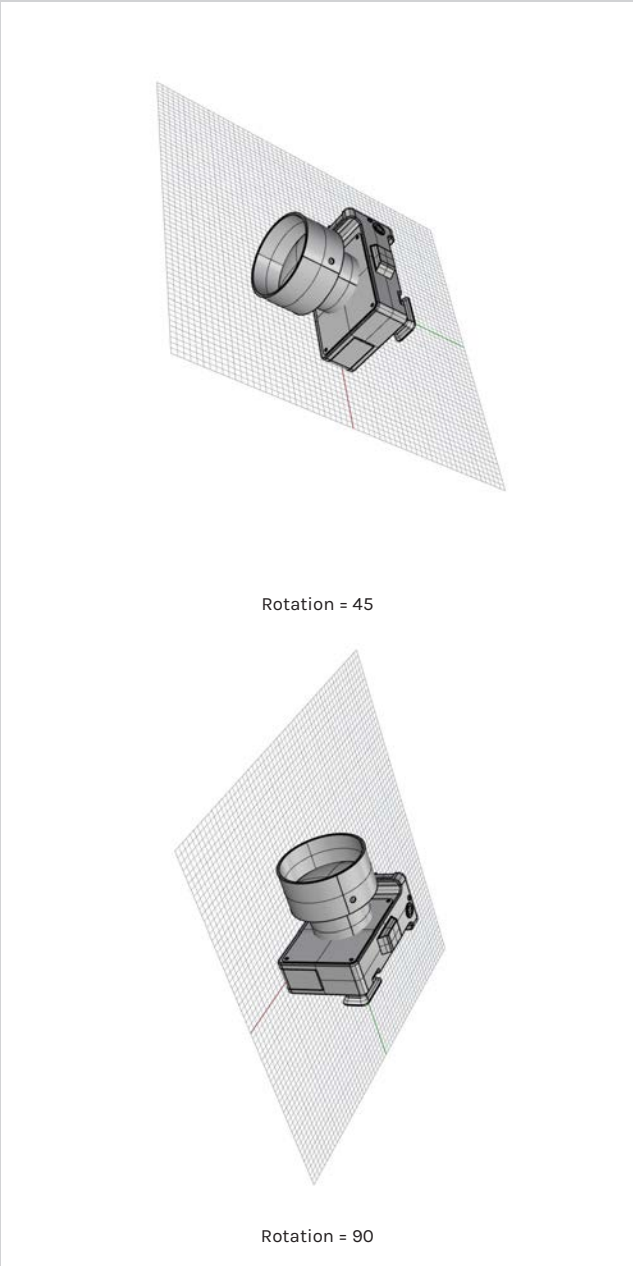
06



07



Camera	
A Lens Length	50.0
B Rotation	0.0
C X Location	117.199
D Y Location	-105.39
E Z Location	83.248
F Distance to Target	188.489
G Location	Place...



08 Camera Settings

The Camera tab let us customize our camera view even further. These settings can only be changed if the camera is not locked (Fig. 08).

A. Lense Length

Defines the focal length of the camera. Does not affect parallel projection.

B. Rotation

Defines the rotation of the camera (Fig. 09).

C. X Location

09 Defines the position of the camera on the world's x-axis.

D. Y Location

Defines the position of the camera on the world's y-axis.

E. Z Location

Defines the position of the camera on the world's z-axis.

F. Distance to Target

Shows the distance to the camera target. This value can not be set manually.

G. Location

Using the "Place..." button will let us manually set the camera position as if we were placing a point.

01 Camera

Target Settings

The target settings let us define the target position for the camera (Fig. 10, 11).

10

A. X Target

Defines the position of the camera target on the worlds x-axis.

B. Y Target

Defines the position of the camera target on the worlds y-axis.

C. Z Target

Using the "Place..." button will let us manually set the camera target position as if we were placing a point.

11

D. Location

Using the "Place..." button will let us manually set the camera target position as if we were placing a point.

Wallpaper Settings

The wallpaper settings let us define an image for the background (Fig. 12).

E. Filename

Defines the path for the wallpaper.

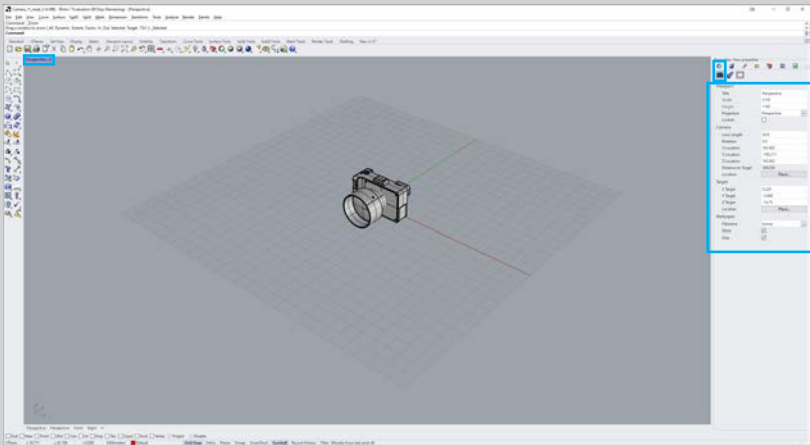
12

F. Show

If unchecked, the wallpaper is not visible.

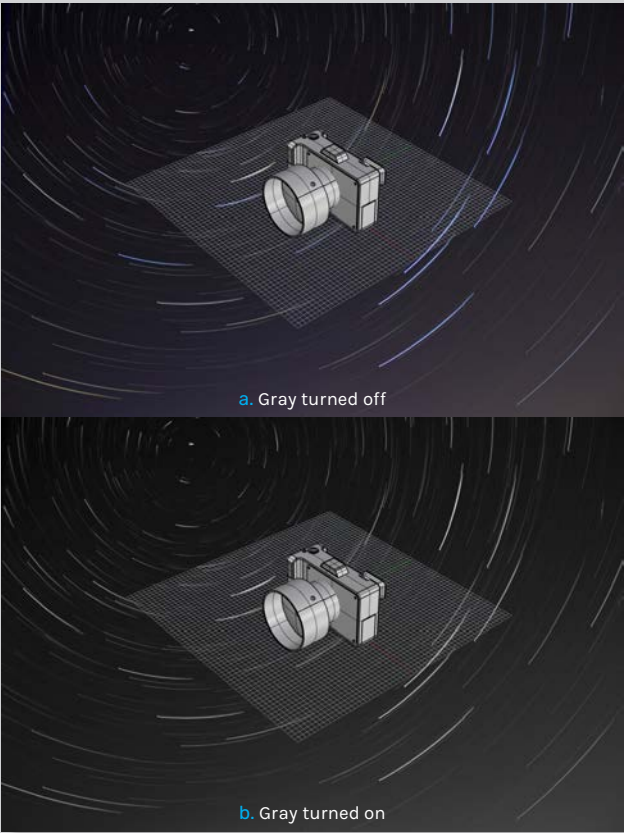
G. Gray

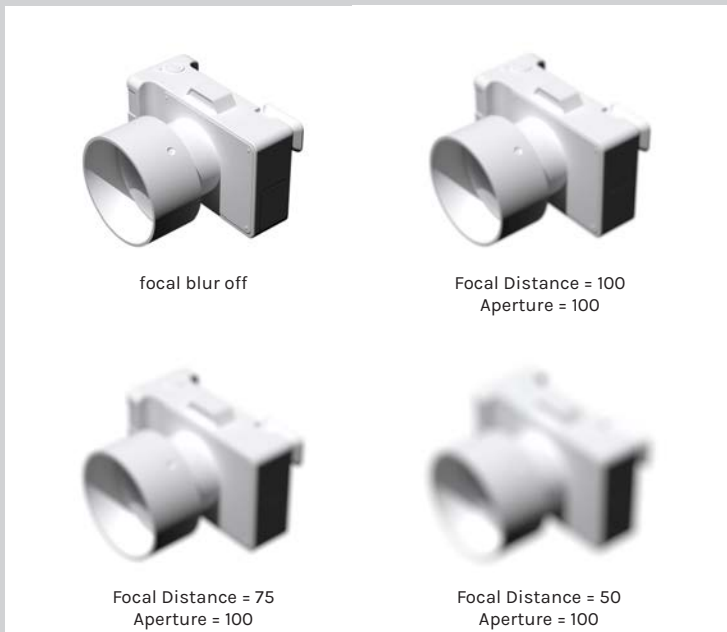
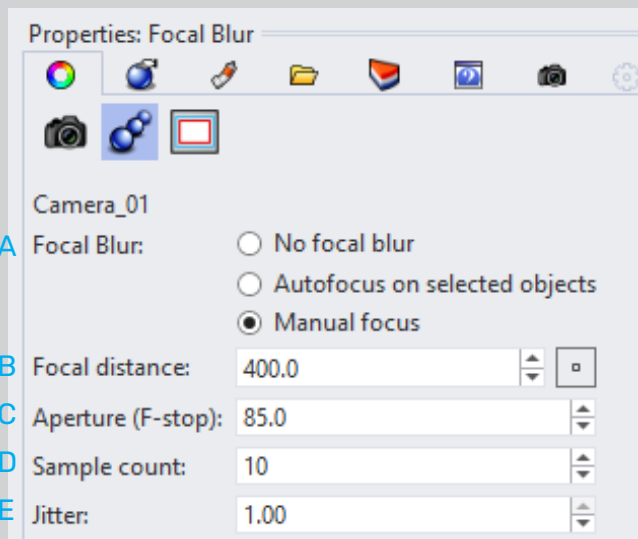
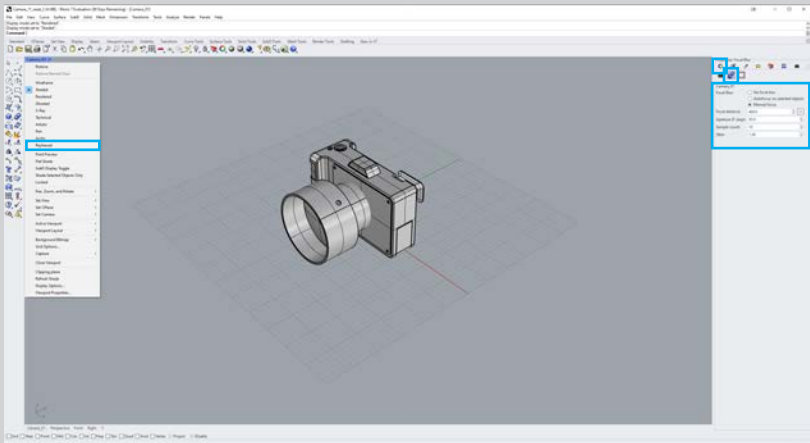
If checked, the wallpaper is displayed in gray-scale colors.



Target	
A X Target	-5.287
B Y Target	7.166
C Z Target	-5.39
D Location	<button>Place...</button>

Wallpaper	
E Filename	(none) ...
F Show	<input checked="" type="checkbox"/>
G Gray	<input checked="" type="checkbox"/>





04 // Focal Blur

13

Focal Blur Settings

The Focal Blur Settings does exactly what its name suggests. It will let us add focal blur to the camera. However, this effect will only be visible when using the "Raytraced" display mode (Fig. 13, 14).

A. Focal Blur

a. No focal blur

The Focal blur is turned off.

b. Autofocus on selected objects

The focal distance is set automatically based on the selected objects.

c. Manual focus

The focal distance is set manually.

14

B. Focal Distance

The distance to a plane perpendicular to the camera that should be in focus [12] (Fig. 15).

C. Aperture (F-stop)

The 35 mm single-lens-reflex camera equivalent aperture [12] (Fig. 15).

D. Sample Count

The number of rays per sub-pixel that is generated for the effect. The higher the count the more accurate and smoother the result, and the longer it takes to render. [12]

15

E. Jitter

Sets the amount of radial noise added to the ray origins. Bigger jitter makes the image noisier, but also hides the steps in shading caused by combining the image from multiple samples. [12]

01 Camera

05 // Safe Frame

Safe Frame

The Safe Frame shows the area of the viewport that will be rendered in the active viewport. These settings are only really important when rendering the image through the "Render" command (Fig. 16, 17).

A. Show Safe Frame in the active view

Defines the position of the camera target on the world's x-axis.

B. Show in perspective views only

Defines the position of the camera target on the worlds y-axis.

C. Live area

Shows the size of the rendered view as a yellow frame in the viewport [13] (Fig. 18).

D. Action area

Shows a user-specified action area frame in blue. Set the percentage of the screen that will be used. When clicking the lock icon - different percentages for the X and Y scaling can be defined [13] (Fig. 18).

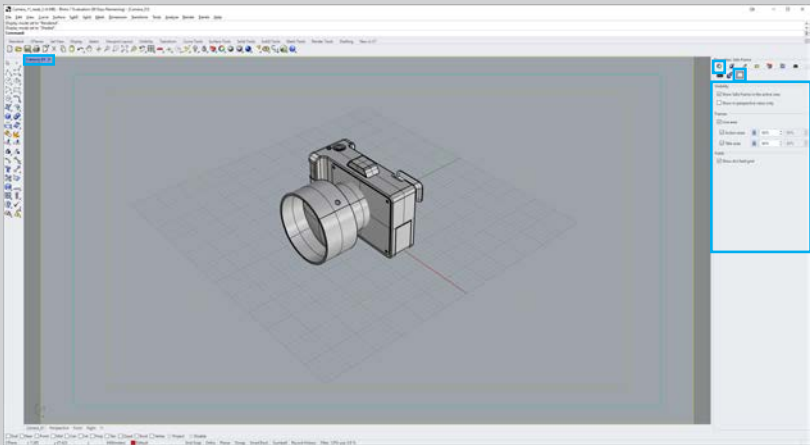
E. Title area

Shows a user-specified title area frame in orange. Set the percentage of the screen that will be used. When clicking the lock icon - different percentages for the X and Y scaling can be defined [13] (Fig. 18).

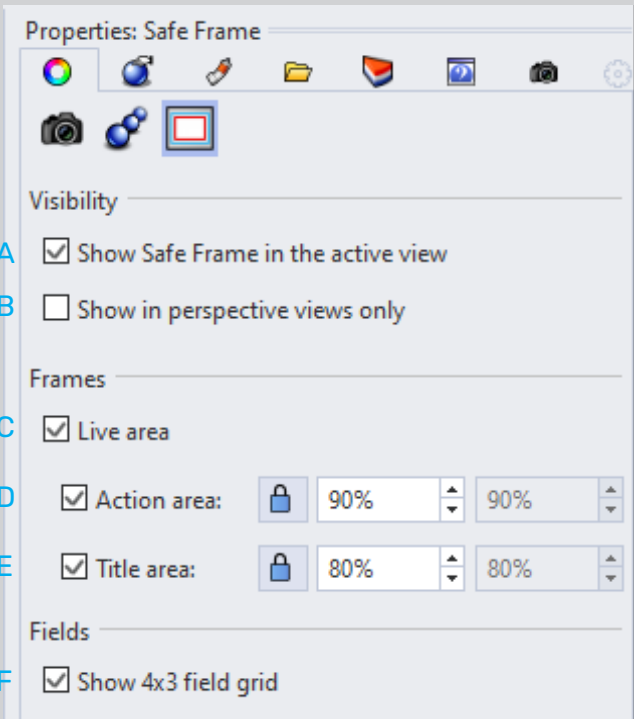
F. Fields

Divides the live area into a 4 by 3 grid which is commonly used for production rendering and film work [13] (Fig. 18).

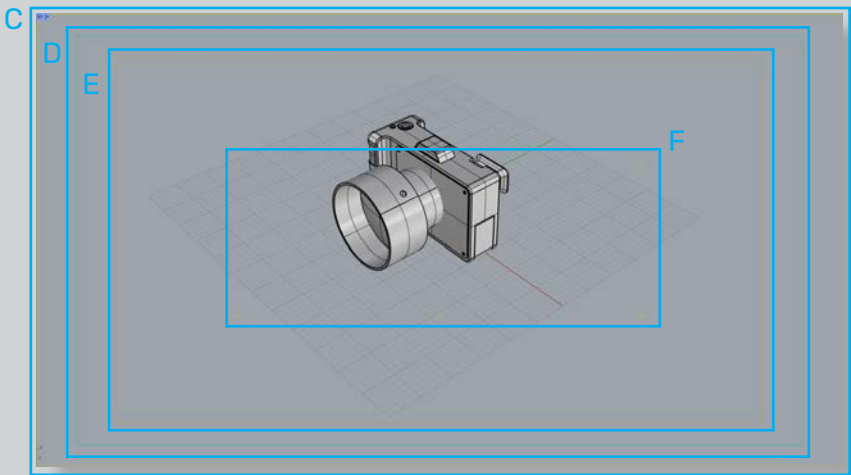
16

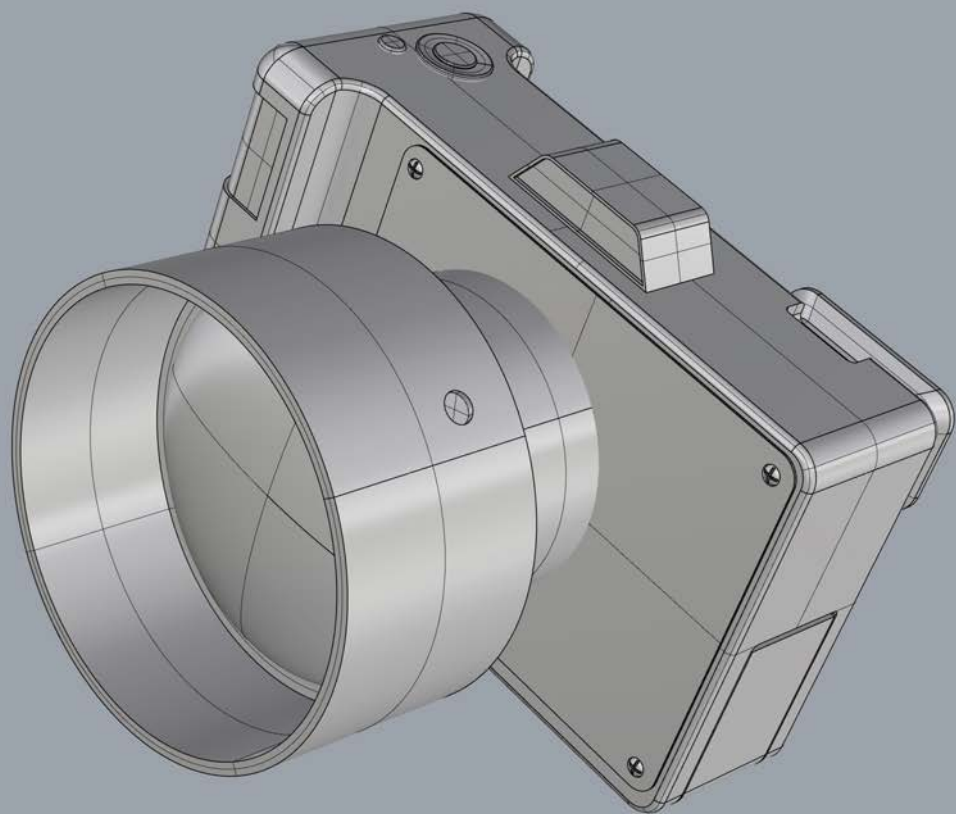


17



18





Chapter 02

- 01 Overview
- 02 Management
- 03 General Settings
- 04 Grid Settings
- 05 Objects Settings
- 06 Shadows Settings
- 07 Other Settings

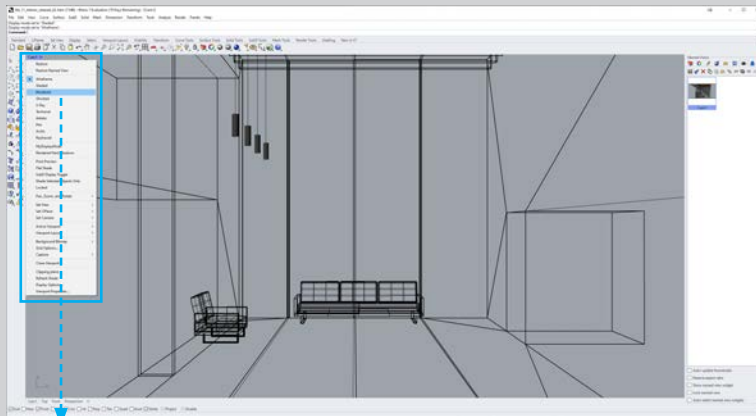
01 // Overview

Display Modes in Rhino

Display Modes are different forms of visual styles for scenes or objects within the viewport. Rhino provides numerous standard display modes for this manner. Additional modes can be created and personalized to individual needs by the user (Fig. 01).

01



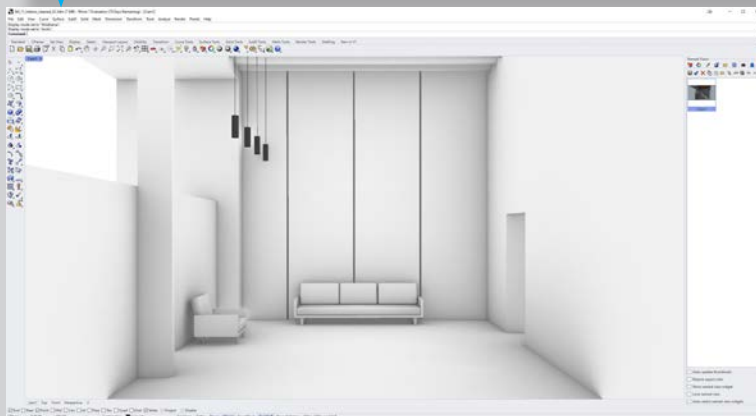


Default Display Modes

By default Rhino offers several Display modes that are ready to be used (Fig. 02).

02

- A. Wireframe
- B. Shaded
- C. Ghosted
- D. Rendered
- E. X-Ray
- F. Technical
- G. Artistic
- H. Pen
- I. Arctic
- J. Raytraced



03

Applying Display Modes

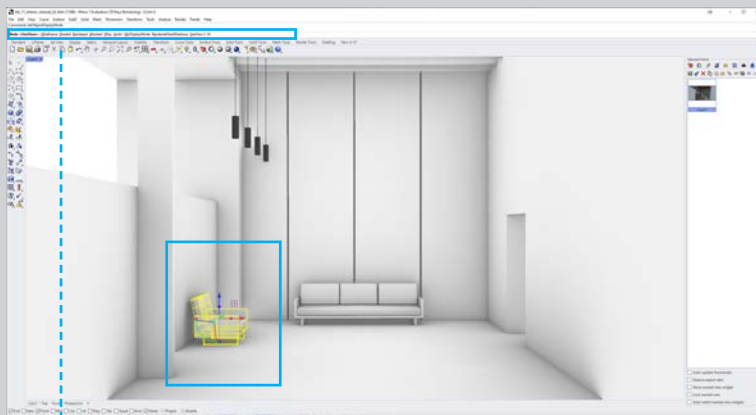
Display Modes can be applied in two different ways.

K. Applying a Display Mode to your scene

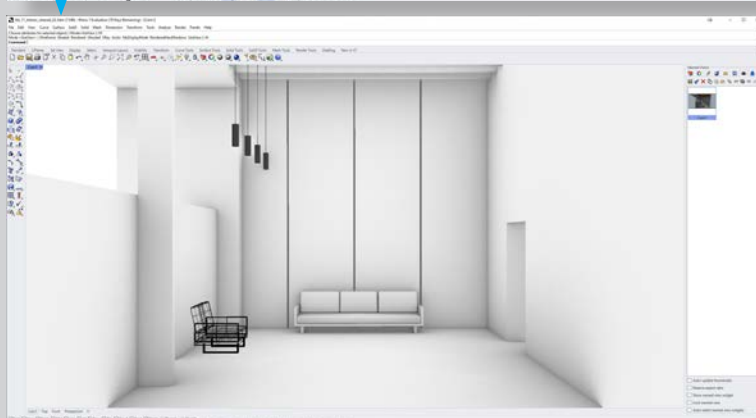
We can choose a display mode for our scene by simply selecting it from the drop-down menu in the Rhino viewport. This will shade all objects accordingly (Fig. 03).

L. Applying a Display Mode to individual objects

Sometimes we want to have more control over the shading process and apply different Display Modes to individual objects at the same time. We can do so by selecting an object and using the "_SetObjectDisplayMode" command (Fig. 04).



04



05

02 Display Modes

02 // Management

The Display Mode Options can be accessed under
Tools -> Options -> View -> Display Modes
(Fig. 03, Fig 04).

All Display Modes shown earlier in this chapter
can be found here. Furthermore, Rhino gives us
different options to modify the collection.

A. New

Create a new Display Mode from scratch
(Fig. 07).

B. Copy

Duplicates the selected Display Mode. This is
useful for adjusting an existing Display Mode
to specific preferences, instead of creating a
new one from scratch (Fig. 07).

C. Delete

Deletes the selected Display Mode (Fig. 07).

D. Export

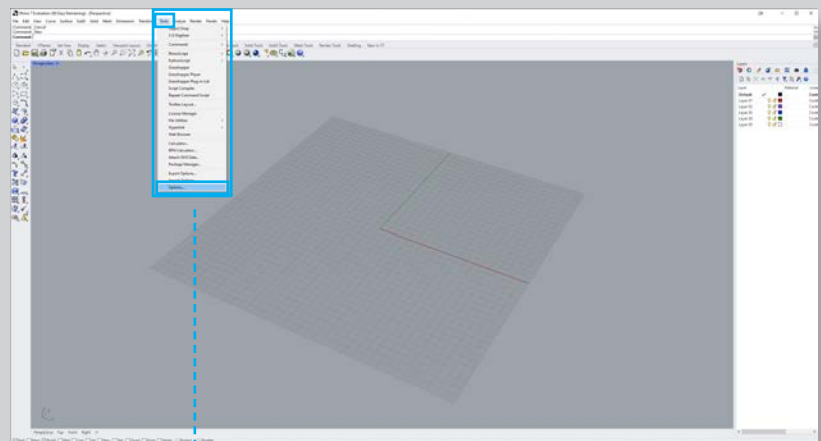
Exports the selected Display Mode as .ini
file. This can be useful when transferring Data
between Workgroups or Projects or simply
backing up the selected Display Mode (Fig. 07).

E. Import

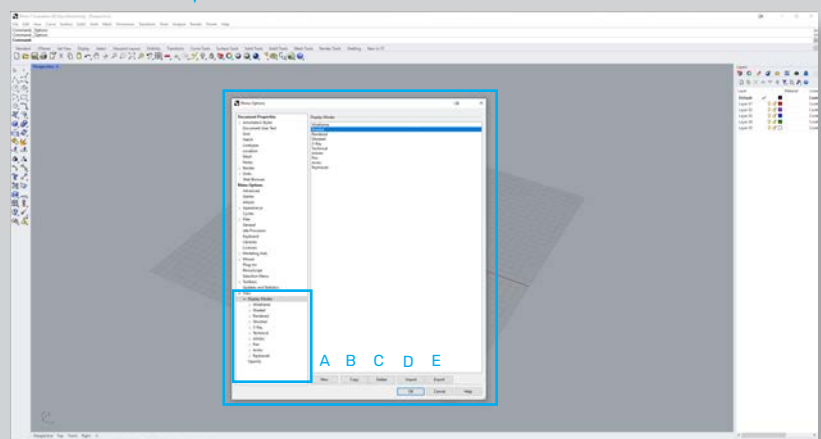
Imports a Display Mode .ini file from your
hard drive (Fig. 07).

By expanding the Display Mode Tab, we can se-
lect any of the existing Display Modes, to view or
modify their settings in more Detail (Fig 07).

06



07

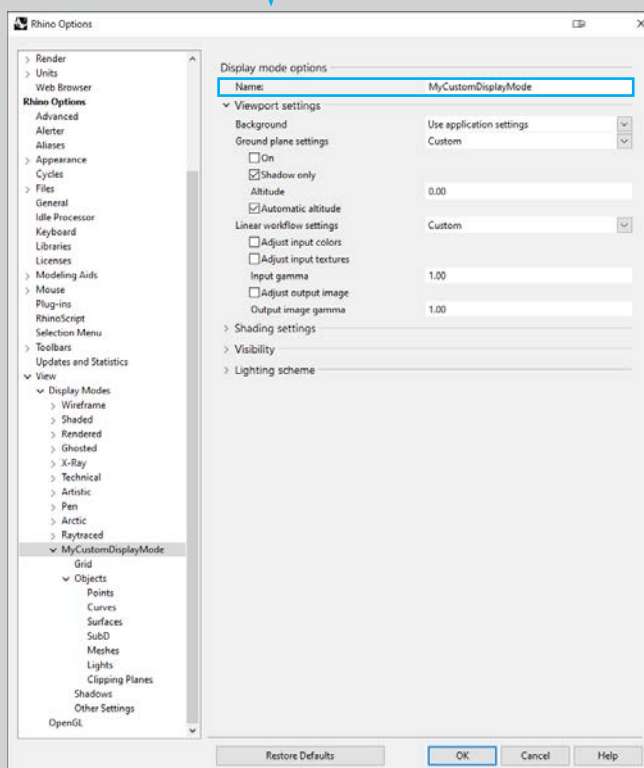
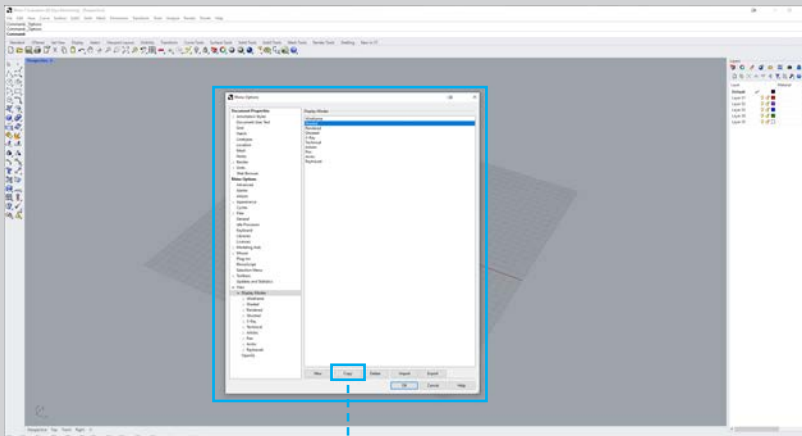


03 // General Settings

08 Depending on the selected Display Mode, the available configuration and settings might differ significantly.

As discussed on the last page, we can create a new Display Mode by pressing the new button or adjusting an existing one. In this example, we will copy the "Shaded" Display Mode (Fig. 08). This will automatically open the Display mode options for our newly created Mode. Right at the top, we can give it a custom name. For this tutorial, we'll go with the name "My Display

09 Mode" (Fig. 09).



02 Display Modes

Viewport Settings

In the next Tab, the Viewport settings, we can choose the Background for our Display Mode (Fig 10).

A. Background

This Tab defines the Viewport Background of Rhino.

a. Use application settings

The Display Mode uses the default application background settings (Fig 11).

b. Solid Color

The Display Mode uses a defined color for its background (Fig 11).

c. Image File

The Display Mode uses an image file for its background (Fig 12).

d. Gradient 2 colors

The Display Mode uses a gradient for its background defines by two-color values (Fig 12).

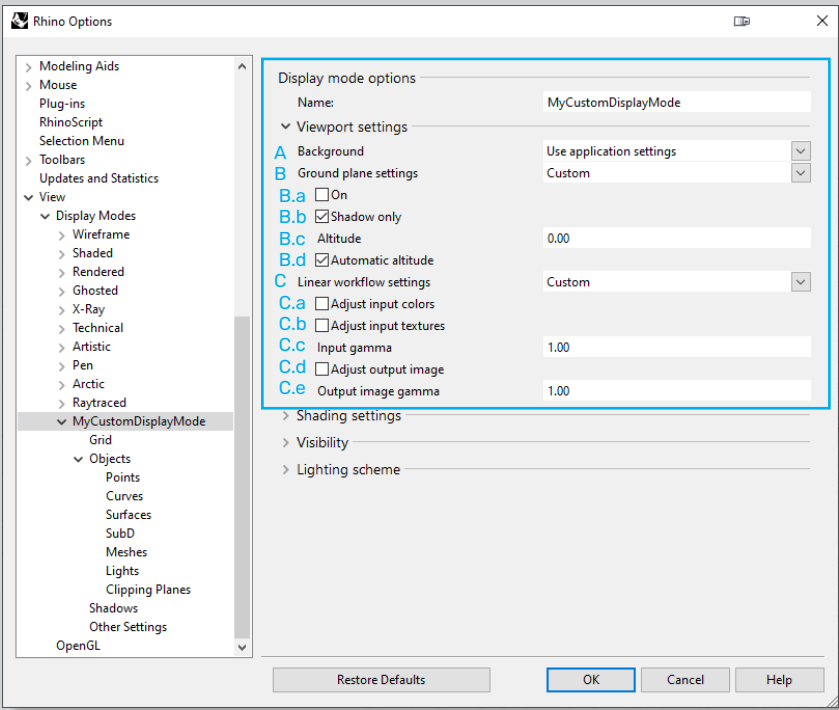
e. Gradient 4 colors

The Display Mode uses a gradient for its background defines by two-color values (Fig 13).

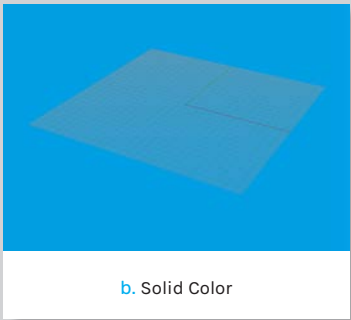
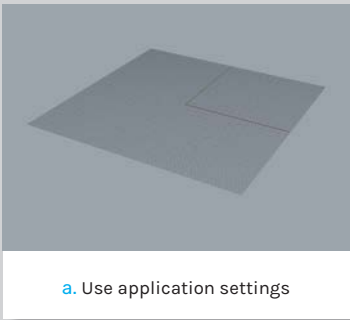
f. Use render settings

The Display Mode uses a gradient for its background defines by two-color values (Fig 13).

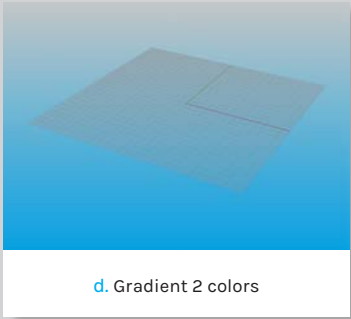
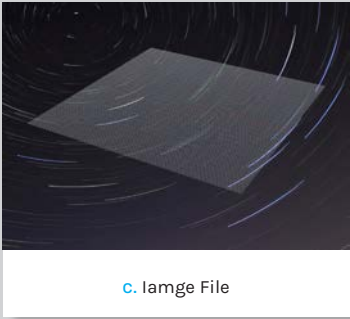
10



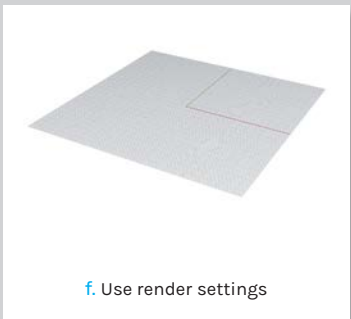
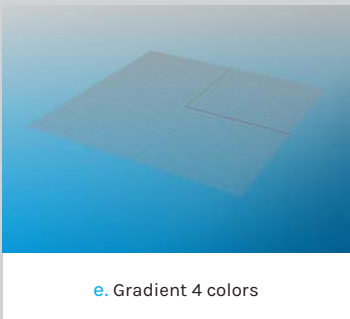
11

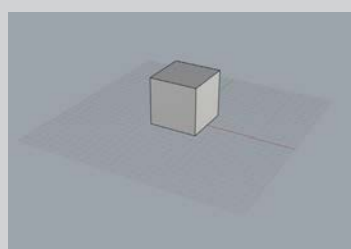


12

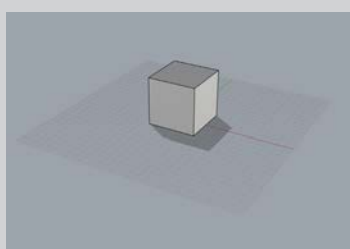


13

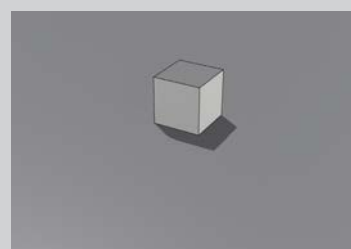




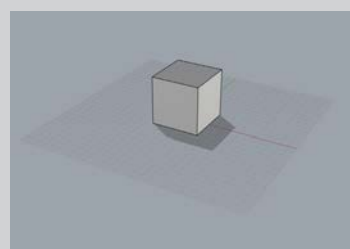
a. On = False



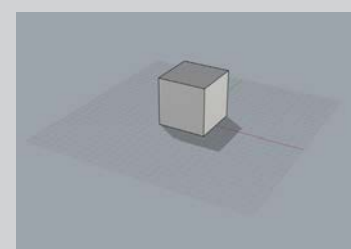
a. On = True



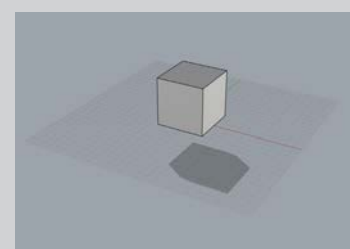
b. Shadow Only = True



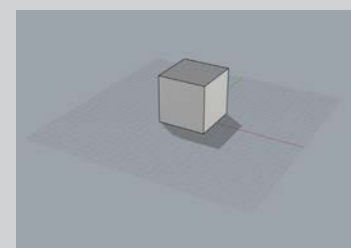
b. Shadow Only = False



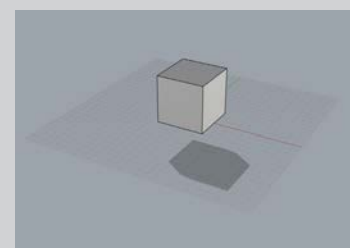
c. Altitude = 0



c. Altitude = -20



d. Automatic altitude = on
altitude = -20



d. Automatic altitude = off
altitude = -20

14

B. Ground Plane Settings

The next Tab gives us the Option to modify the Ground Plane of our scene. We can choose between using the render settings or defining a custom appearance to the ground plane. For the custom option, the following settings are available (Fig 10).

a. On

Decides if a ground plane is used (Fig 14).

b. Shadow Only

The ground plane itself is not displayed, but shadows can still be cast on it.

Useful when using the command "View CaptureToFile" or creating a render output file with transparent background (Fig 15).

c. Altitude

This defines the position of the ground plane on the world z-axis (Fig 16).

d. Automatic altitude

The ground altitude is adjusted to the lowest geometry on the world's z-axis.

Overrides "Altitude" setting (Fig 17).

15

16

C. Ground Plane Settings

The term linear workflow is used to describe an approach to shading, lighting, and rendering by properly converting colors. Again, we can choose to use the render settings or to define our custom properties, which gives us the following options:

17

a. Adjust input colors

If set to true, Rhino uses the input gamma value for color correcting any colors feed into Rhino.

b. Adjust input textures

The ground plane itself is not displayed, but shadows can still be cast on it.

Useful when using the command "View CaptureToFile" or creating a render output file with transparent background.

c. Input gamma

Defines the gamma value for correcting input colors and textures.

d. Adjust output image

If set to true, Rhino uses the output gamma value for color correcting any images exported through Rhino.

e. Output image gamma

Defines the gamma value for correcting output images.

02 Display Modes

Shading Settings

The Shading settings tab gives us several options to modify the appearance of meshes and surfaces in our scene. (Fig. 18).

A. Shade Objects

Objects are rendered solid (Fig 19).

B. X-Ray all wires

Lines and Edges are visible through solid surfaces (Fig 20).

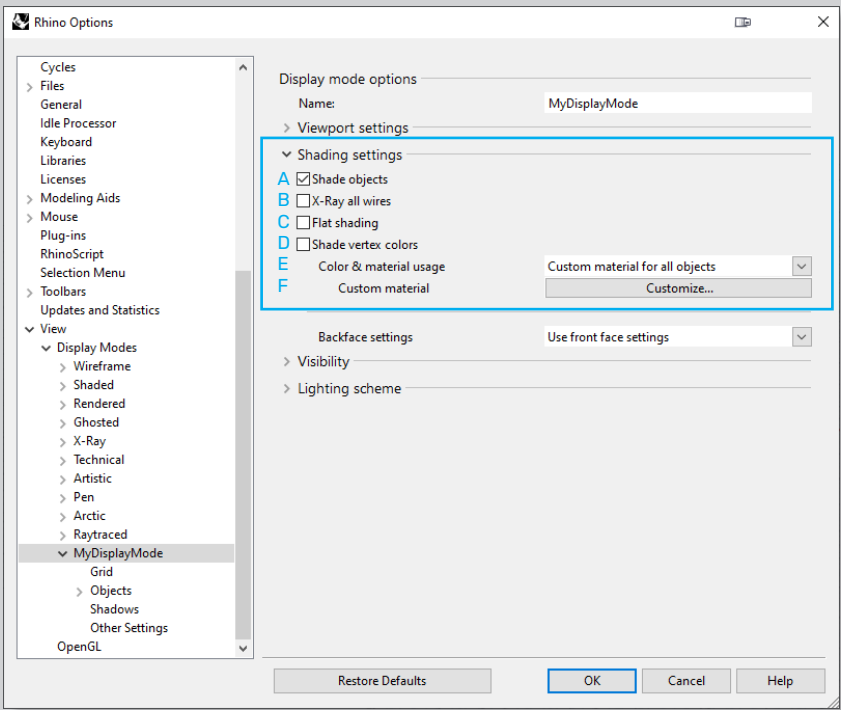
C. Flat Shading

All surfaces and mesh faces are rendered flat. Predefined normal configurations are ignored (Fig 21).

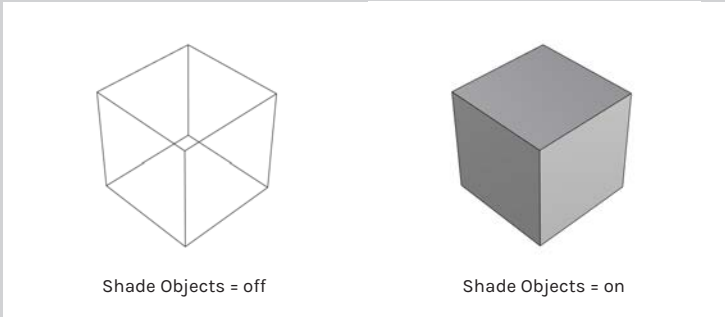
D. Shade Vertex Colors

The vertex colors of meshes are used for shading (Fig 22).

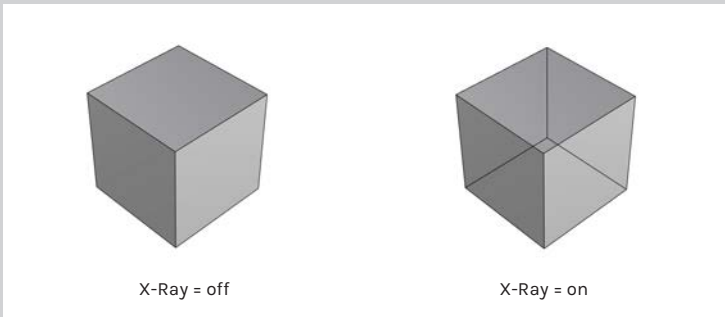
18



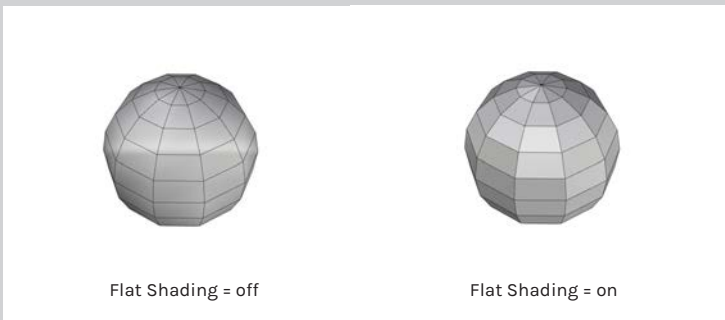
19



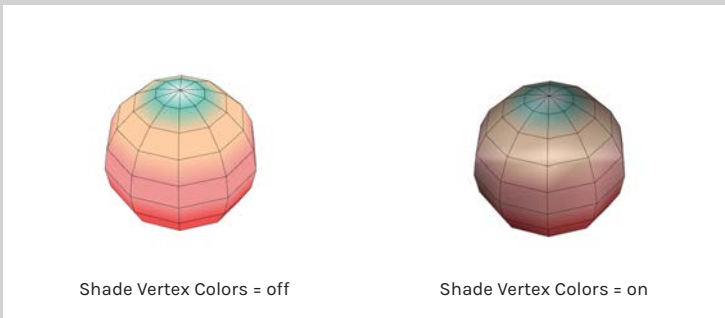
20

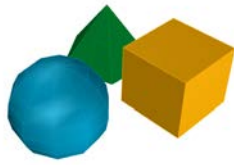


21

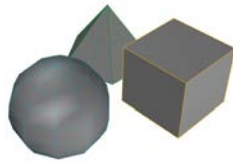


22

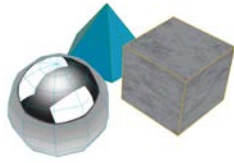




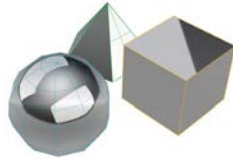
a. Objects Color



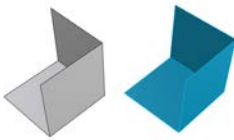
b. Single Color



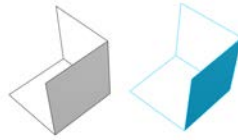
c. Rendering Material



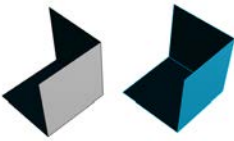
d. Custom Material



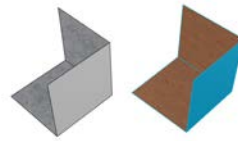
a. Use front face settings



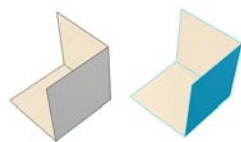
b. Cull backfaces



c. Single color for all backfaces



d. Rendering material



e. Custom material for all backfaces

23

E. Color and Material usage

Defines the material and color appearance of objects (Fig. 23).

a. Objects Color

Uses objects layer color for shading.

b. Single Color

Uses a single color for shading.

c. Rendering Material

Uses the rendering material for shading.

d. Custom Material

Uses the a custom material for shading.

F. Backface Settings

Defines how backfaces of objects are displayed (Fig. 13).

a. Use front face settings

Shades backfaces the same as front faces.

b. Cull backfaces

Backfaces are not visible.

c. Single color for all backfaces

All backfaces are shaded in one color.

d. Rendering material

Backfaces are shaded with the objects rendering material.

e. Custom material for all backfaces

Backfaces are shaded with custom material.

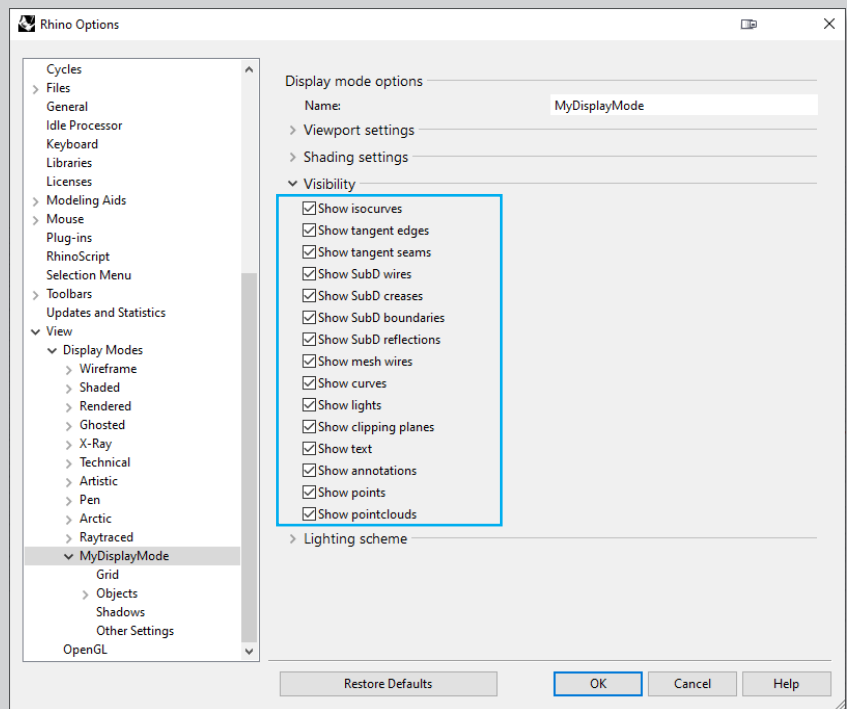
24

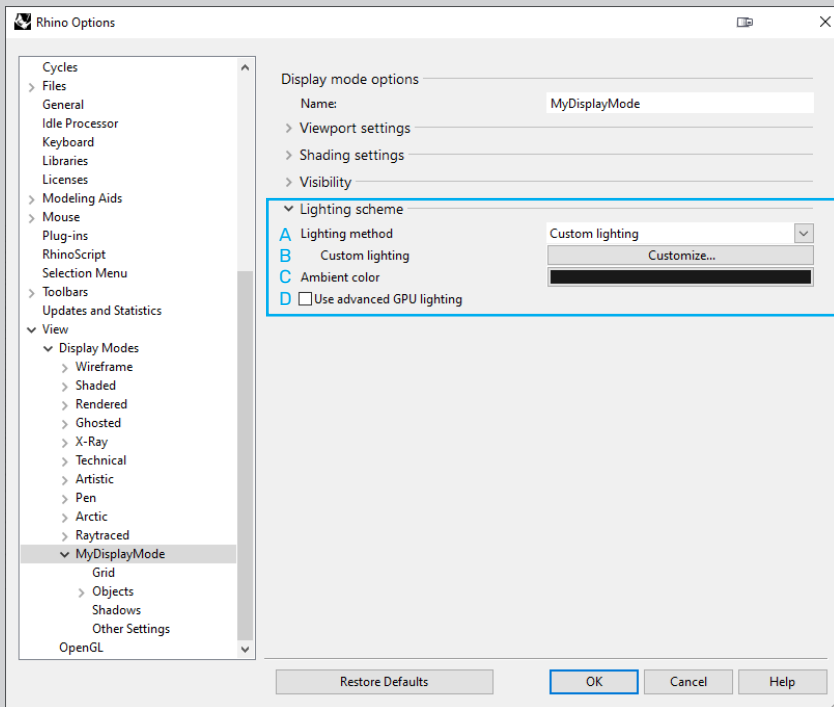
02 Display Modes

Visibility Settings

The visibility tab let us decide which objects we want to show or hide from the viewport when using our Display Mode (Fig. 25).

25





Lighting Settings

26 The Lighting scheme tab gives us control over the lighting and thus the shading in our scene (Fig. 26).

A. Lighting Method

The lighting method defines the lighting used by our display mode (Fig. 27).

a. No lighting

Uses flat shading for all objects.

b. Default lighting

Uses the default lighting of Rhino, which is described in the Rhino documentation as "headlamp" light.

c. Scene lighting

Uses the lights that are placed in the scene.

d. Ambient occlusion

Uses ambient occlusion for lighting.

e. Custom lighting

This option let us define a custom lighting setup. When selected, a new "Customize..." button will appear below the Lighting Method menu. If we press on it a new window will appear that will let us define up to eight different lights.

i. The x, y and z values define the direction vector of our light.

ii. The color swatch defines the diffuse color of our light.

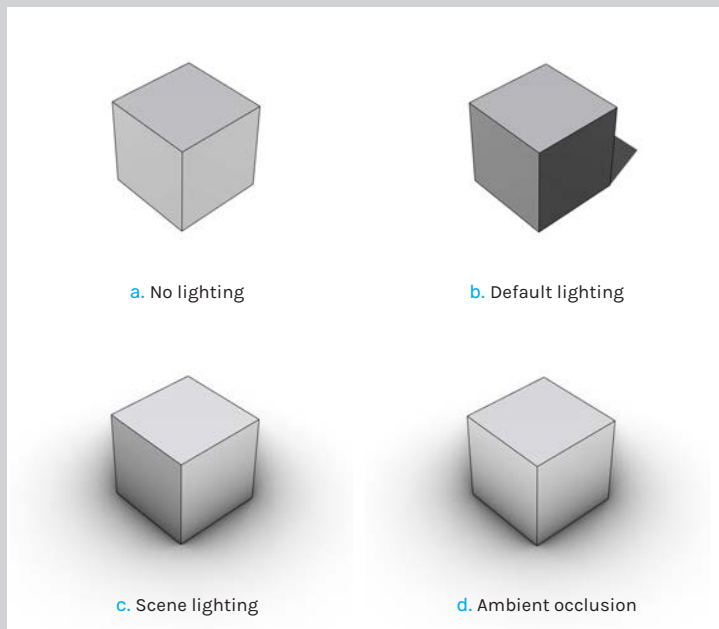
iii. The specular swatch defines the specular color of our light

B. Ambient color

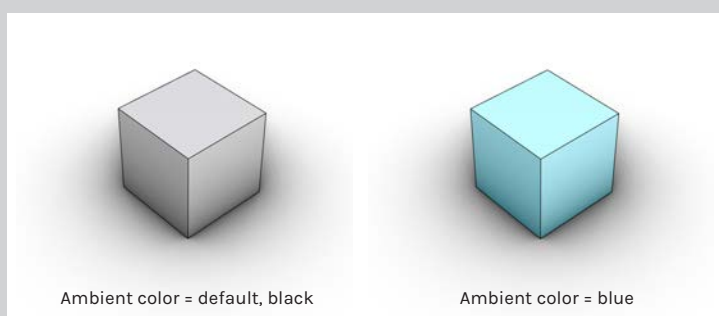
Sets the color for ambient lighting (Fig. 28).

C. Use advanced GPU lighting

Uses advanced GPU lighting for shading. This means, that lighting calculations are done for all pixels within the viewport which results in greater detail. This must be checked when bump mapping is used.



Note:
Ground Plane and Shadows are set active in these images.



27

28

02 Display Modes

04 // Grid Settings

Grid Settings

As the name already suggests, the Grid Settings **29** tab let us decide how the Rhino grid should be displayed when our Display Mode is enabled (Fig. 29).

A. Grid Usage

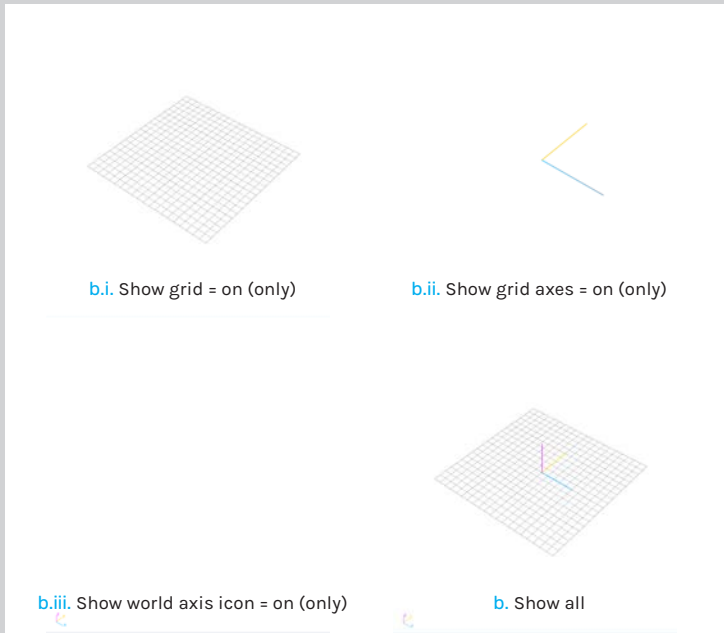
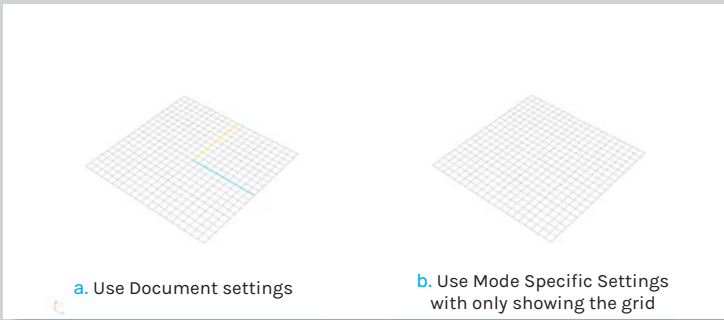
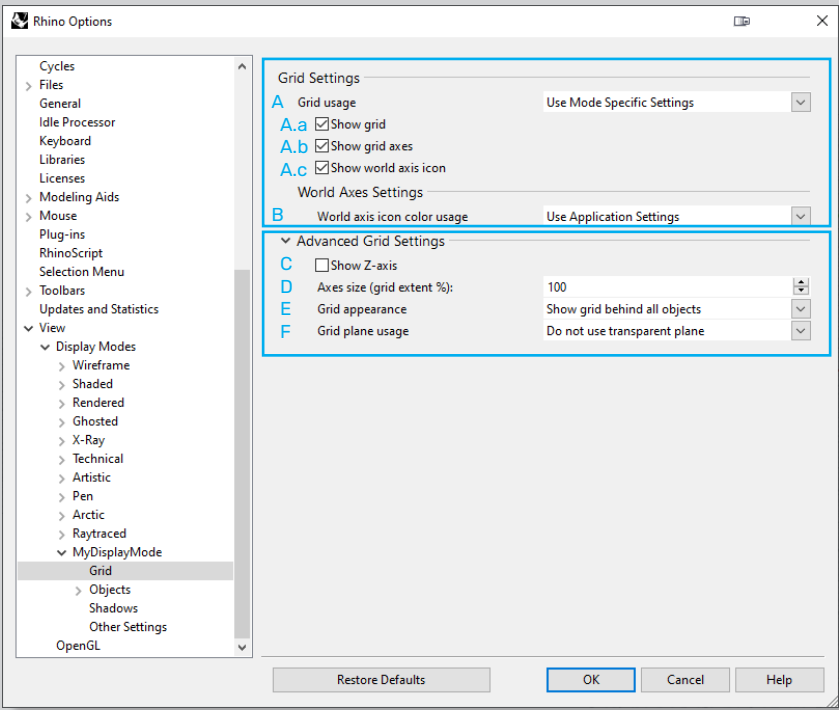
Manages the grid appearance for the scene. We can choose between using the document settings or defining mode-specific settings. For the mode specific option, the following settings are available (Fig. 29).

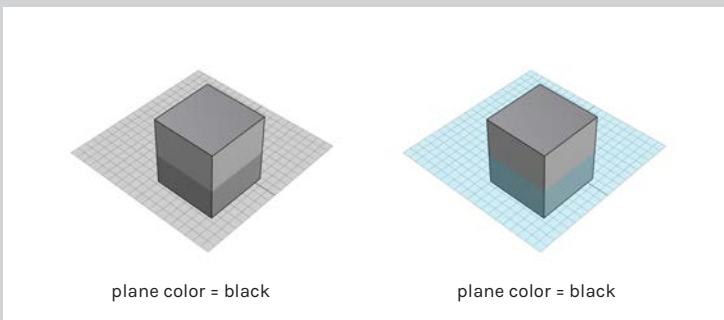
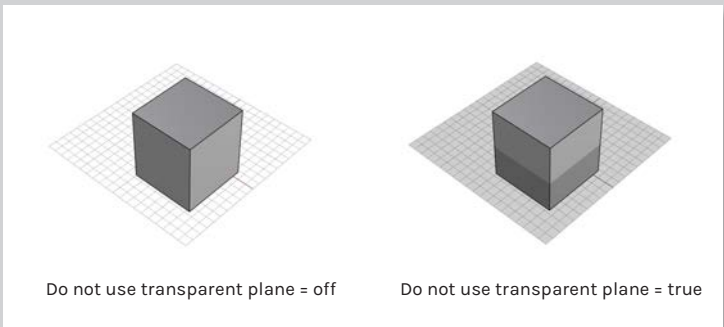
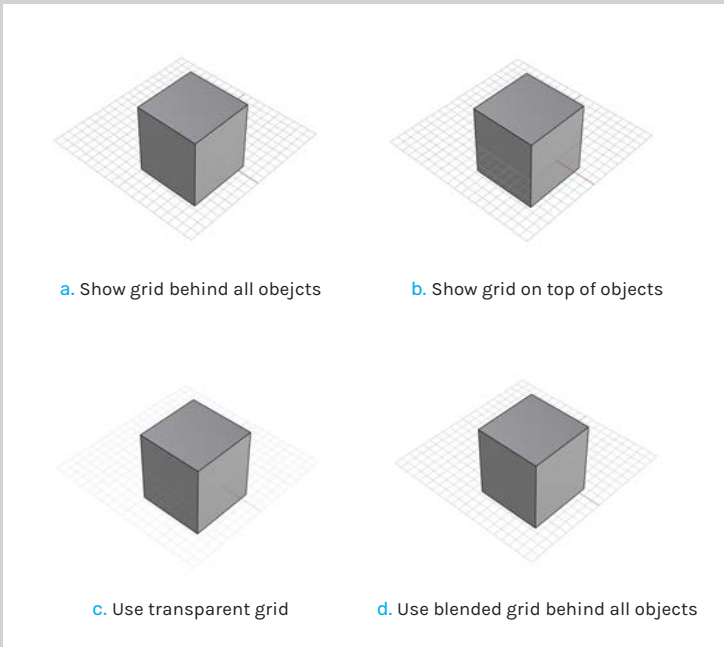
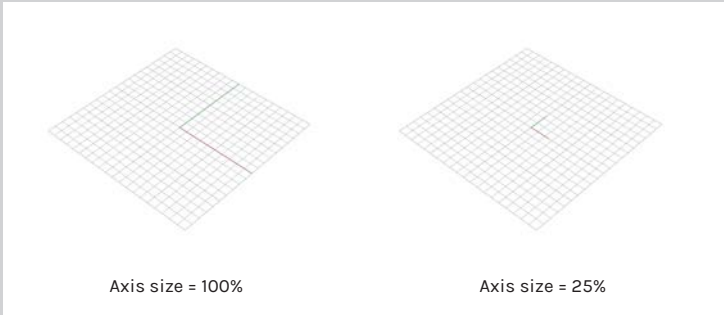
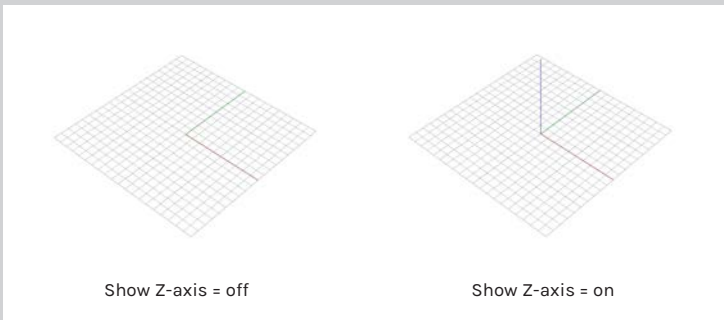
- a. **Show grid**
Shows the grid.
- b. **Show grid axes**
Shows grid axes (Fig. 30).
- c. **Show world axis icon**
Shows the world axis icon if set to true (Fig. 31).

B. World Axis icon color usage

Manages the world axis icon appearance for the scene.

- a. **Use Application Settings**
Uses the document settings.
- b. **Use same as grid axis colors**
Uses the colors of the world axis.
- c. **Use same as grid axis colors**
Use specified custom colors
 - i. Defines the X-axis icon color.
 - ii. Defines the Y-axis icon color.
 - iii. Defines the Z-axis icon color.





32

Advanced Grid Settings

The Advanced Grid Settings Tab let us handle more specific how we want the grid to be displayed in our Scene (Fig. 29).

C. Show Z-Axis

33

If checked, the World Z-Axis will show up in the viewport (Fig. 32).

D. Axes size (grid extent %)

This value will define the visual length of our grid axes (Fig. 33).

E. Grid Appearance

This setting let us decide how the grid is displayed in relation to other objects (Fig. 34).

34

a. Show grid behind all objects

The grid is shown behind objects.

b. Show grid on top of objects

The grid is shown in front of objects.

c. Use transparent grid

The grid is displayed transparent. A new transparency option will appear.

i. Defines the transparency value.

d. Use blended grid behind objects

The grid is displayed transparent. A new transparency option will appear.

i. Defines the transparency value.

F. Grid plane usage

This setting let us decide if the grid plane is displayed (Fig. 35).

a. Do not use transparent plane

No grid plane is displayed.

35

b. Use transparent plane

The grid plane is displayed. A set of new options will be available for customization.

i. Defines the grid plane color (Fig. 36).

ii. Defines the grid planes transparency.

iii. Defines the grid plane visibility. The "show always" option will show the grid plane, even if the grid is not.

36

02 Display Modes

05 // Objects Settings

The Object Settings Tab lets us choose how all the different object types of Rhino are displayed when using the display mode (Fig. 37).

Selection

This section handles whether surfaces, polysurfaces and meshes are shaded when selected (Fig. 37).

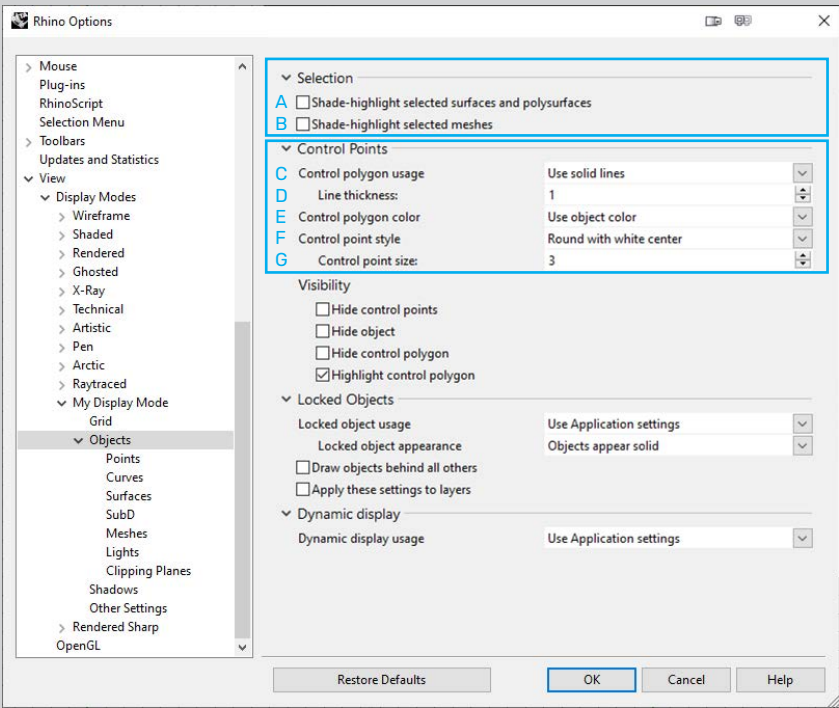
A. Shade-highlight selected surfaces and polysurfaces

Shades selected surfaces and polysurfaces with a highlight color (Fig. 38).

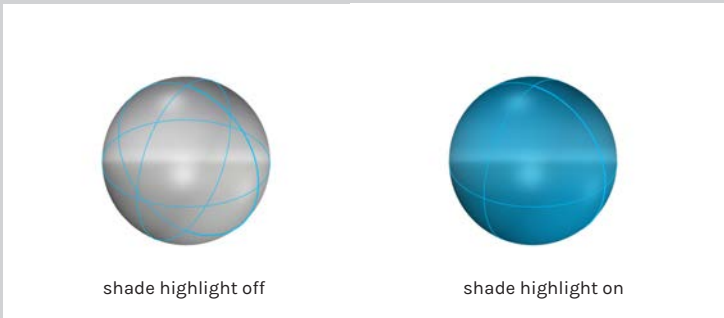
B. Shade-highlight selected meshes

Shades selected meshes with a highlight color (Fig. 39).

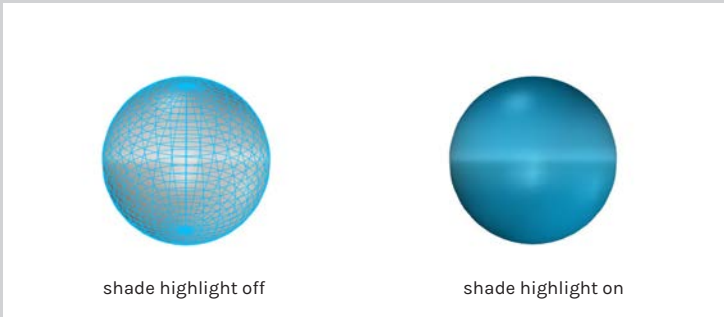
37

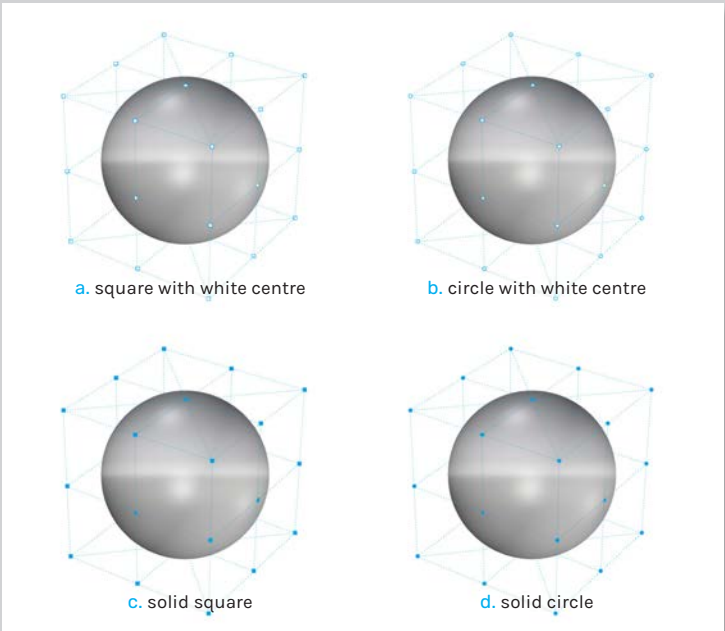
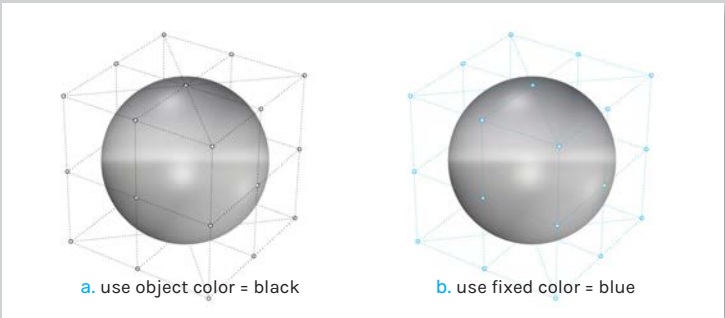
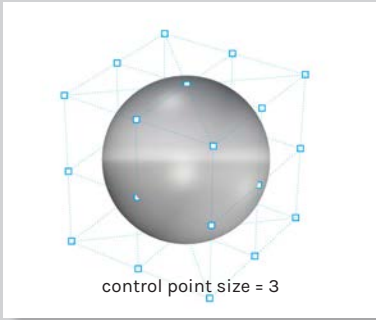
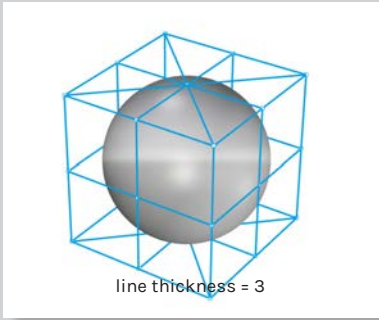
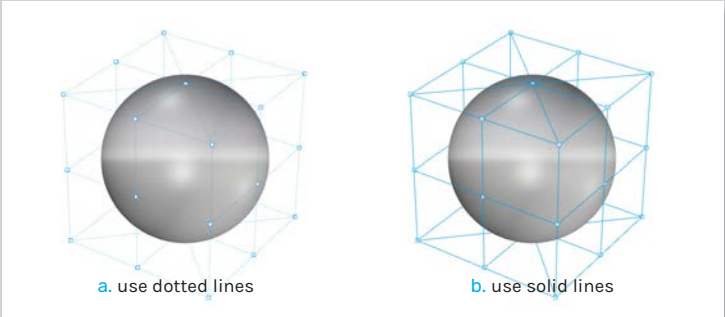


38



39





Control Points

40 This section handles the appearance of control polygons (Fig. 37).

C. Control polygon usage

- a. Use solid lines

Uses solid lines for the control polygon (Fig. 40).
- b. Use dotted lines

Uses dotted lines for the control polygon (Fig. 40).

41

42

D. Line thickness

Sets the width of the control polygon in pixels (Fig. 41).

E. Control polygon color

- a. Use object color

Uses the color defined in the objects properties for the control polygon (Fig. 43).
- b. Use fixed color

Sets a custom color for all control polygons (Fig. 43).

43

F. Control point style

Sets the control point style (Fig. 44).

- a. Square with white center
- b. Round with white center
- c. Solid square
- d. Solid circle

44

G. Control point size

Sets the control point size in pixels (Fig. 42).

02 Display Modes

Visibility

This section handles the visibility properties of control polygons (Fig. 45).

45

A. Hide control points

Hides only the control points and only shows the control polygon (Fig. 46).

B. Hide object

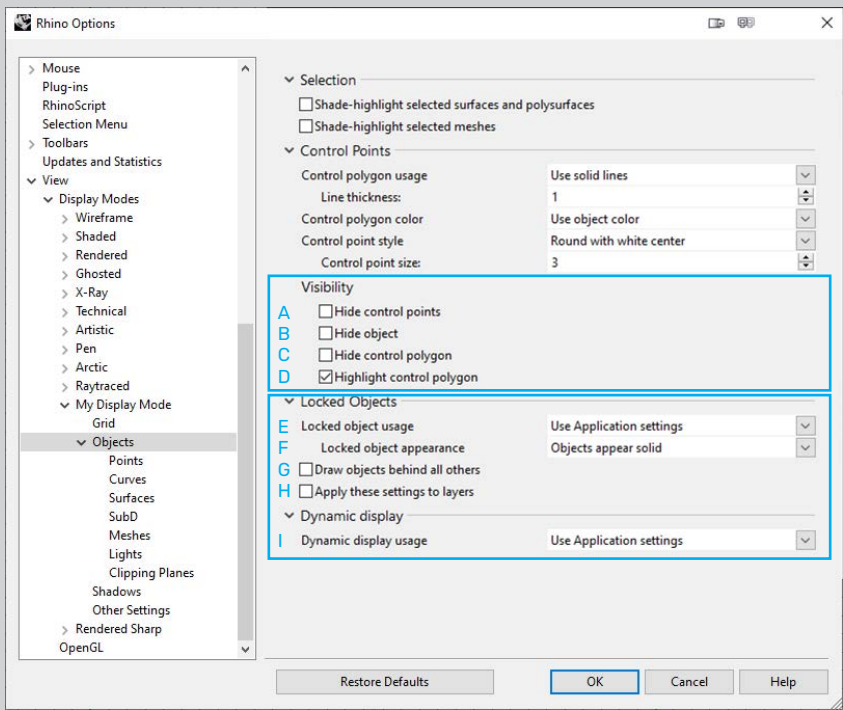
Hides the object while the control polygon is displayed (Fig. 46).

C. Hide control polygon

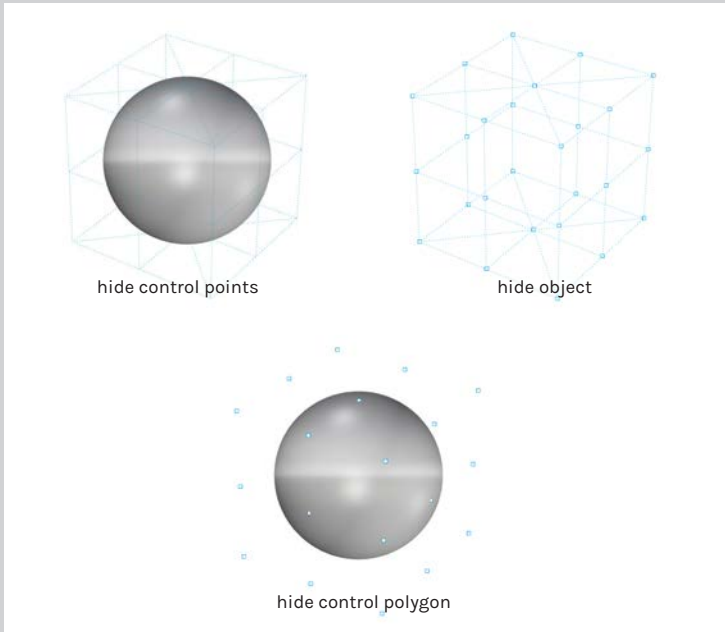
Hides the control polygon and only shows the control points (Fig. 46).

D. Highlight control polygon

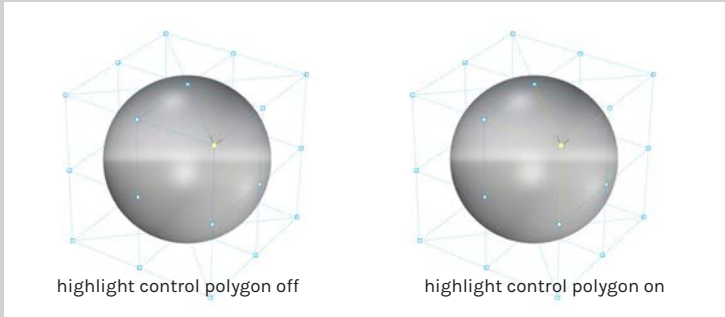
Highlights the segments of the control polygon on either side of the control points (Fig. 47).

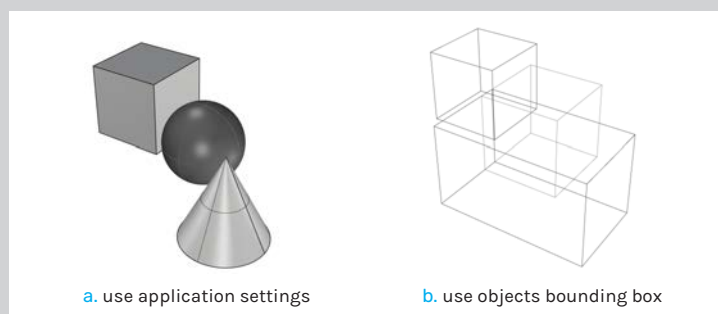
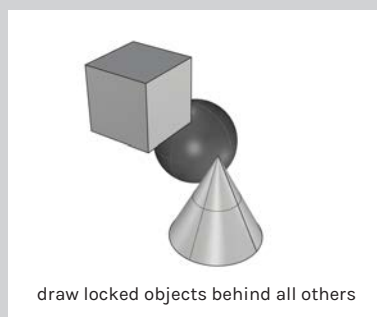
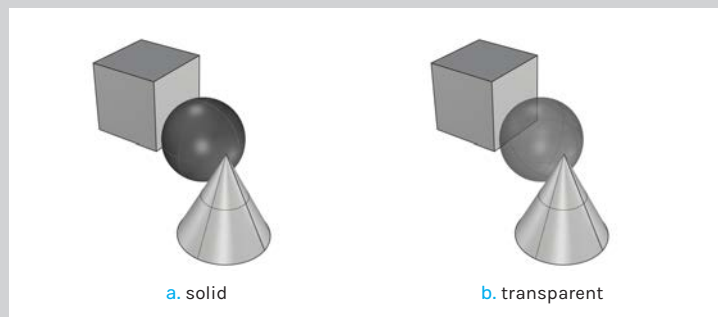
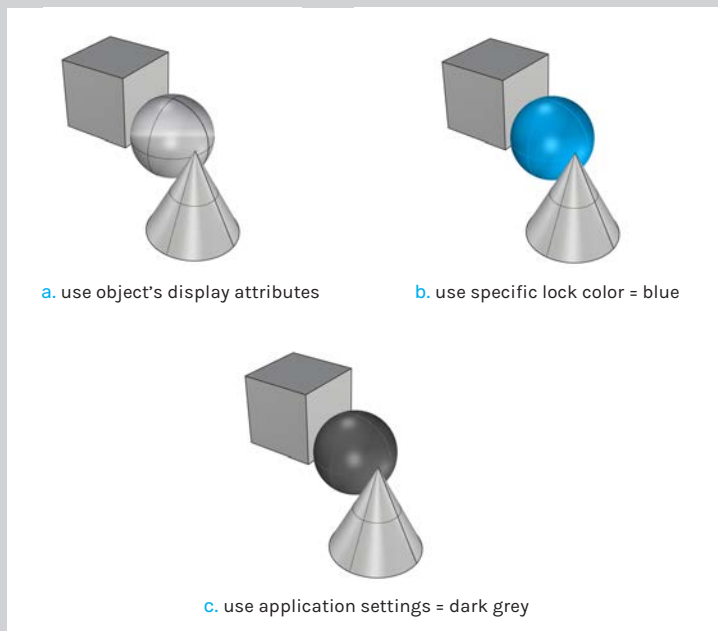


46



47





Locked Objects

48 This section handles how locked objects are displayed (Fig. 45).

E. Locked object usage

a. Use object's display attributes

Uses the objects display settings defined in the object's attributes (Fig. 48).

b. Use specified lock color

Sets a custom color for locked objects (Fig. 48).

c. Use application settings

Uses the application settings for locked objects (Fig. 48).

F. Locked object appearance

a. Objects appear solid

Locked objects are displayed solid (Fig. 49).

b. Objects appear transparent

Sets locked objects transparent. The transparency amount is set in percentage (Fig. 49).

49

G. Draw objects behind all others

Locked objects are drawn behind all other objects (Fig. 50).

H. Apply these settings to layers

50 Applies the settings for locked objects also to locked layers.

Dynamic display

This section sets the appearance of objects when the view is moved or rotated (Fig. 45).

I. Dynamic display usage

a. Use Application settings

Uses the system default settings to display objects (Fig. 51).

b. Display object's bounding box

Reduces the display of objects to their bounding boxes. This can speed up the display on large models (Fig. 51).

51

02 Display Modes

05.01 // Points

Point object settings

Defines the appearance of point objects when using the Display Mode (Fig. 52).

A. Point Style

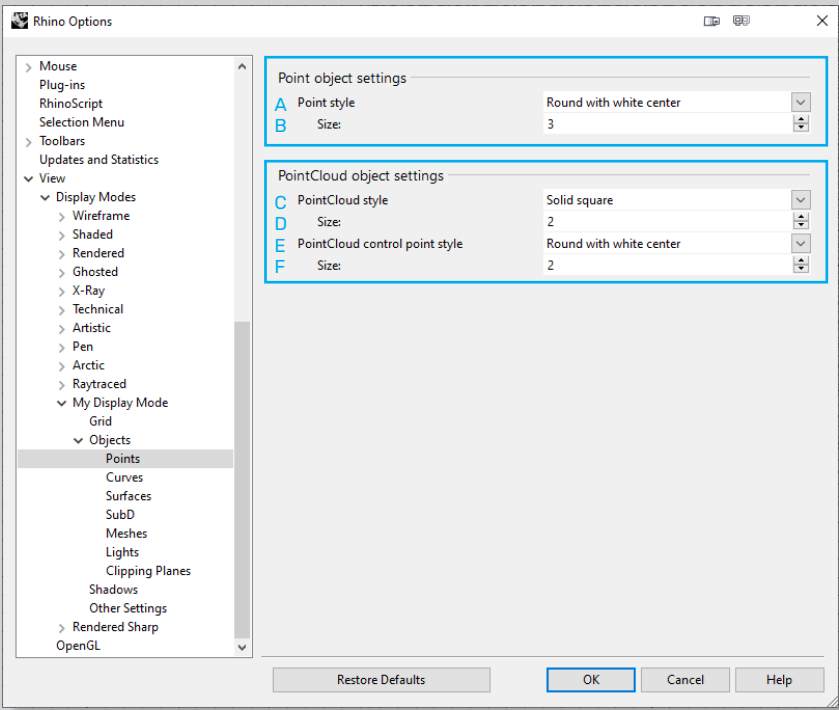
Defines the shape of point objects (Fig. 53).

- a. Square with white center
- b. Round with white center
- a. Solid square
- b. Solid circle

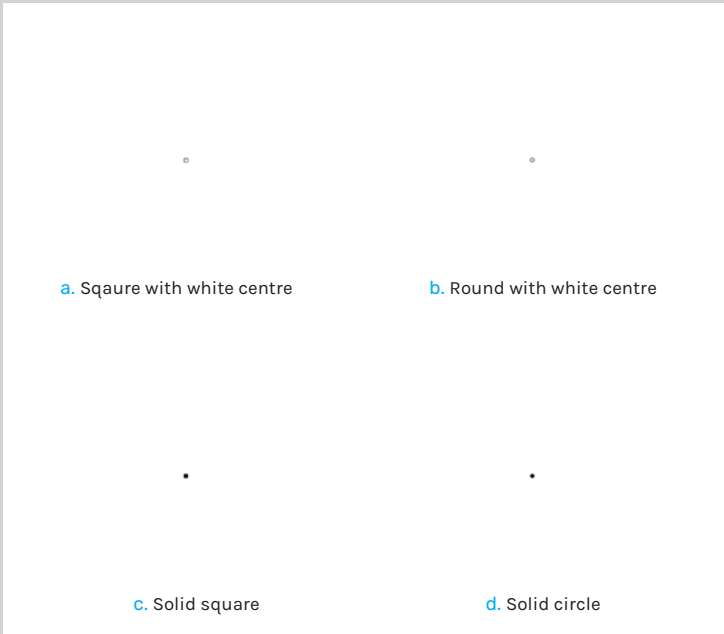
B. Size

Sets the size of point objects in pixels (Fig. 54).

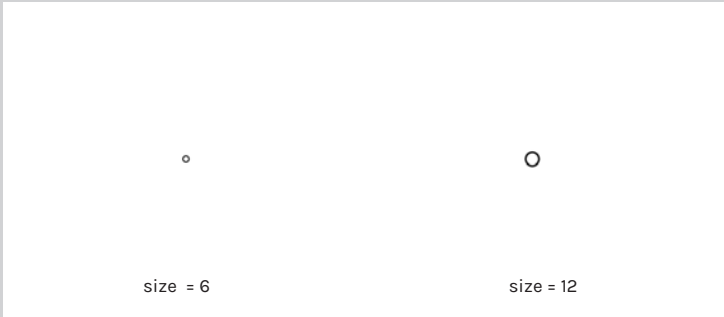
52

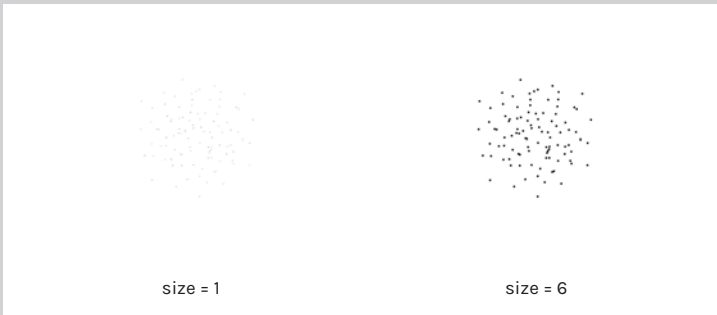
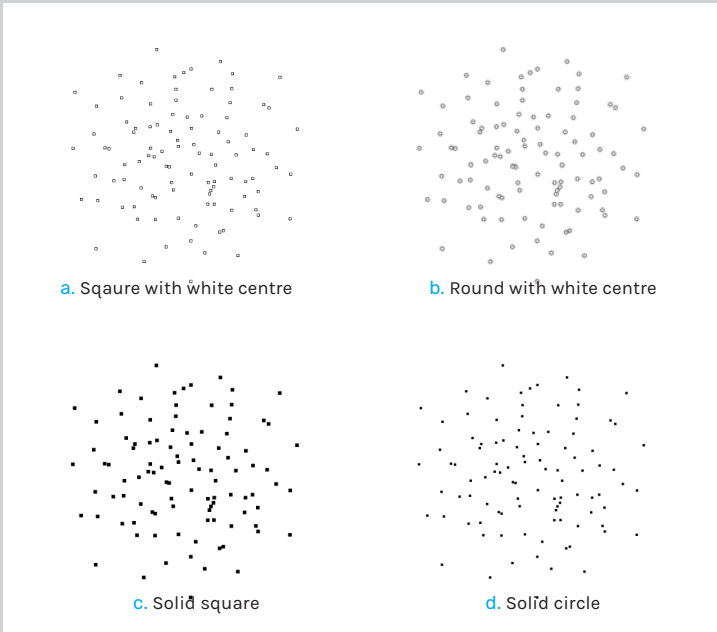


53



54





Note: PointCloud styles and PointCloud Control Point styles have similar settings. They appear exactly the same when using the same configuration.

PointCloud object settings

55 Defines the appearance of point cloud objects when using the Display Mode (Fig. 52).

C. PointCloud style

Defines the shape of the point cloud objects (Fig. 55).

- a. Square with white center
- b. Round with white center
- a. Solid square
- b. Solid circle

D. Size

Defines the size of the point cloud objects in pixels (Fig. 56).

E. PointCloud control point style

Defines the shape of the point cloud control points (Fig. 55).

- 56**
- a. Square with white center
 - b. Round with white center
 - a. Solid square
 - b. Solid circle

F. Size

Defines the size of the point cloud control points in pixels (Fig. 56).

02 Display Modes

05.02 // Curves

Curve settings

Defines the appearance of point objects when using the Display Mode (Fig. 57).

A. Curve color usage

Defines the color for curve objects (Fig. 58).

a. Use object's color

Uses the color defined in the curve's object Properties.

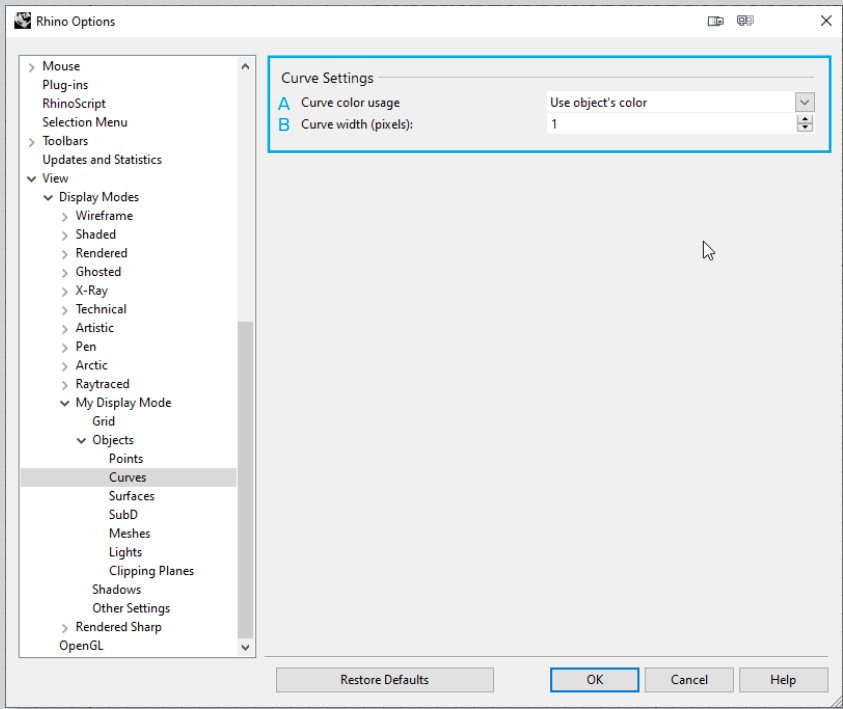
b. Use single color for all curves

Sets a custom color for all curves.

B. Curve width (pixels)

Sets the curve width in pixels (Fig. 59).

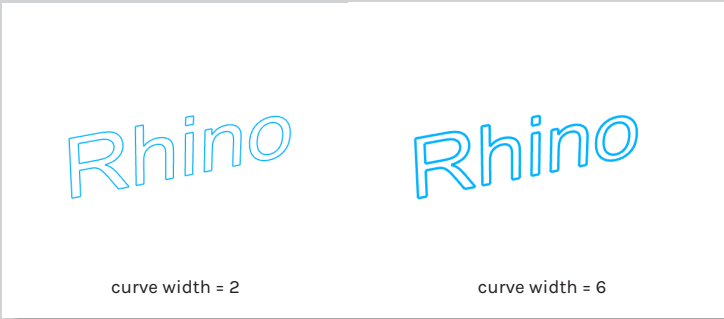
57

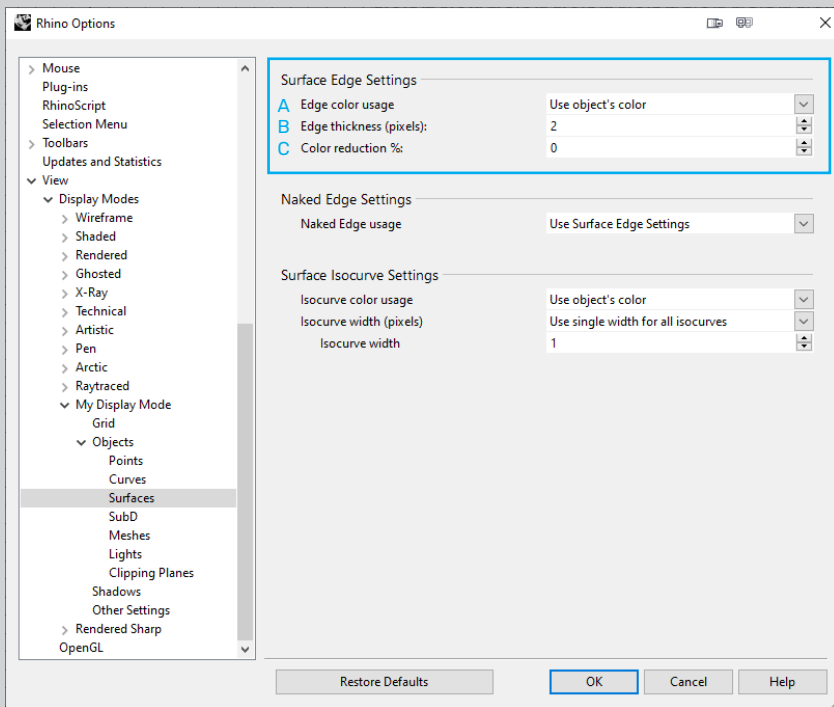


58



59





60

05.03 // Surfaces

Surface Edge Settings

Defines the appearance of surface edges when using the Display Mode (Fig. 60).

A. Edge color usage

Defines the color for edges (Fig. 61).

a. Use objects's color

Uses the color defined in the surface object's Properties.

b. Use isocurve color

Uses the color defined for isocurves for all surface edges.

c. Use single color for all edges

Sets a custom color for all surface edges.

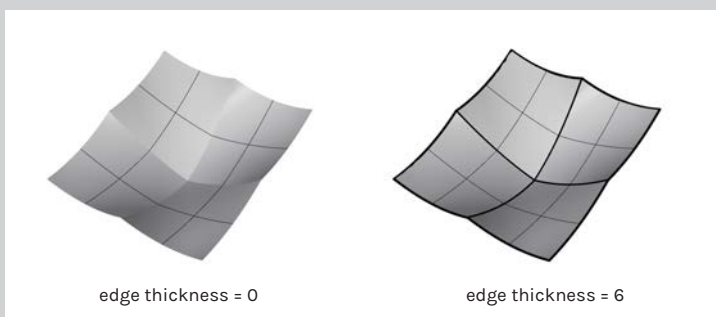
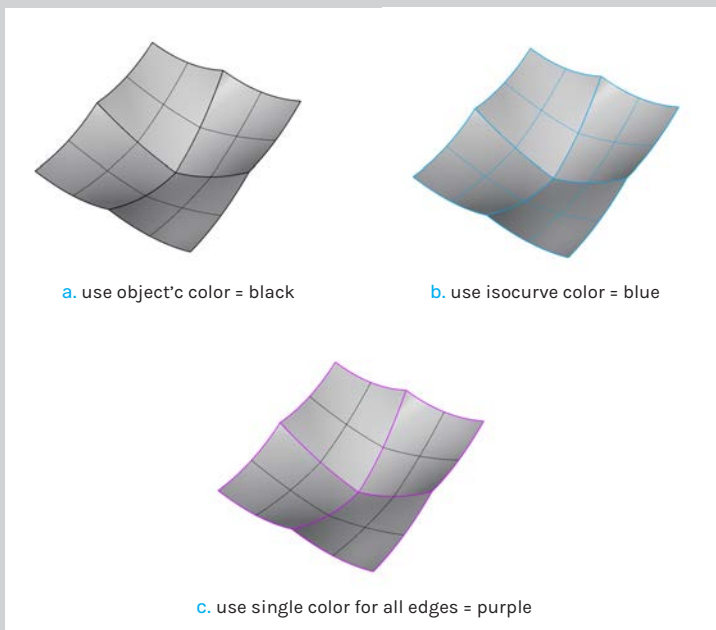
B. Edge thickness (pixels)

61

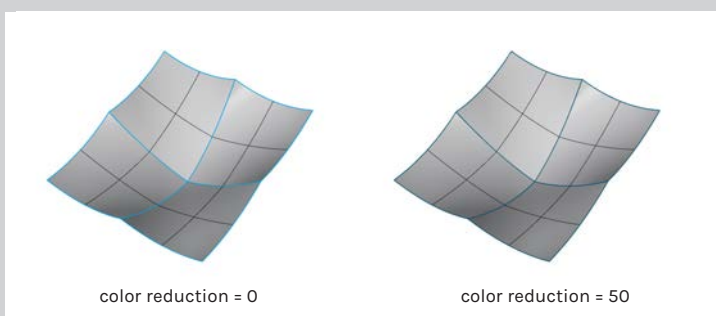
Sets the edge thickness in pixels (Fig. 62).

C. Color reduction %

Lightens the edge color by a percentage (Fig. 63).



62



63

02 Display Modes

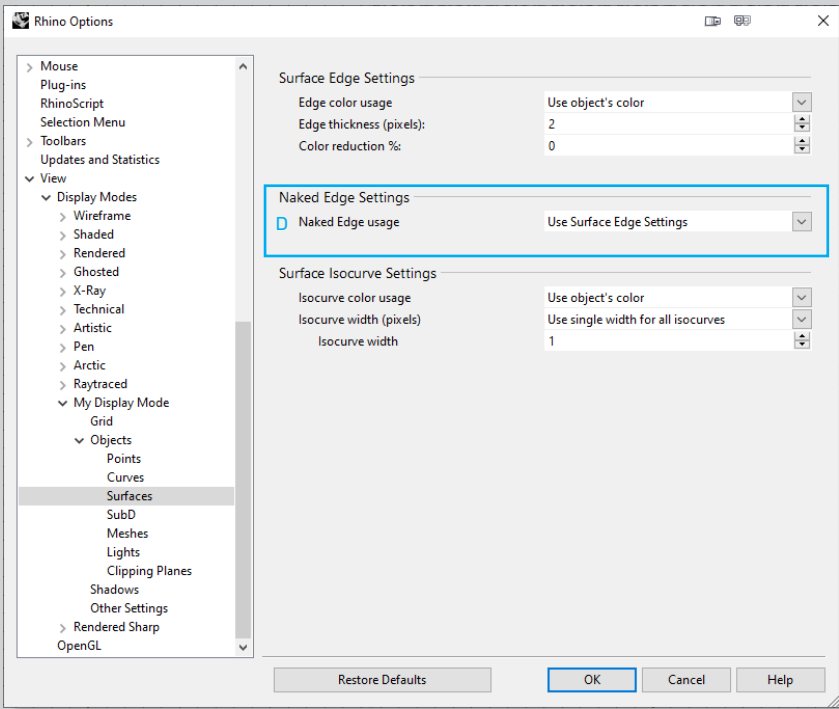
Naked Edge Settings

Defines the appearance of naked edges when using the Display Mode (Fig. 64).

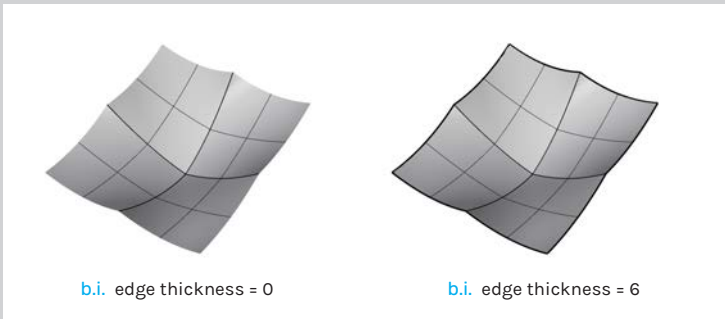
D. Naked Edge usage

- a. Use Surface Edge Settings
 - Uses the same color that is defined for surface edges for naked edges (Fig. 65).
- b. Use separate settings for naked edges
 - i. Edge Thickness (pixels)
 - Sets the naked edge thickness in pixels (Fig. 65).
 - ii. Color Reduction %
 - Lightens the naked edge color by a percentage (Fig. 66).
 - iii. Edge color usage
 - Sets the color for naked edges (Fig. 67).

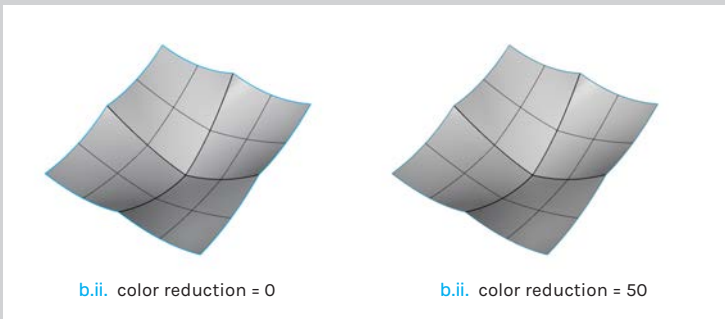
64



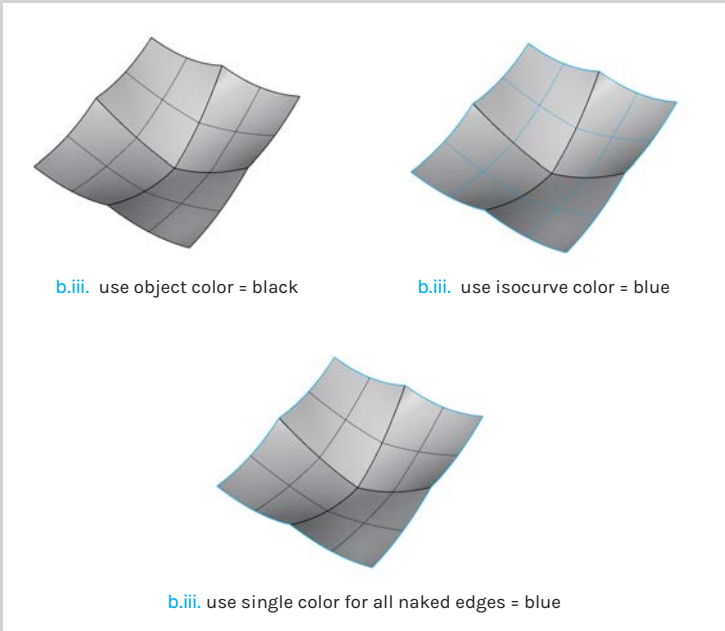
65

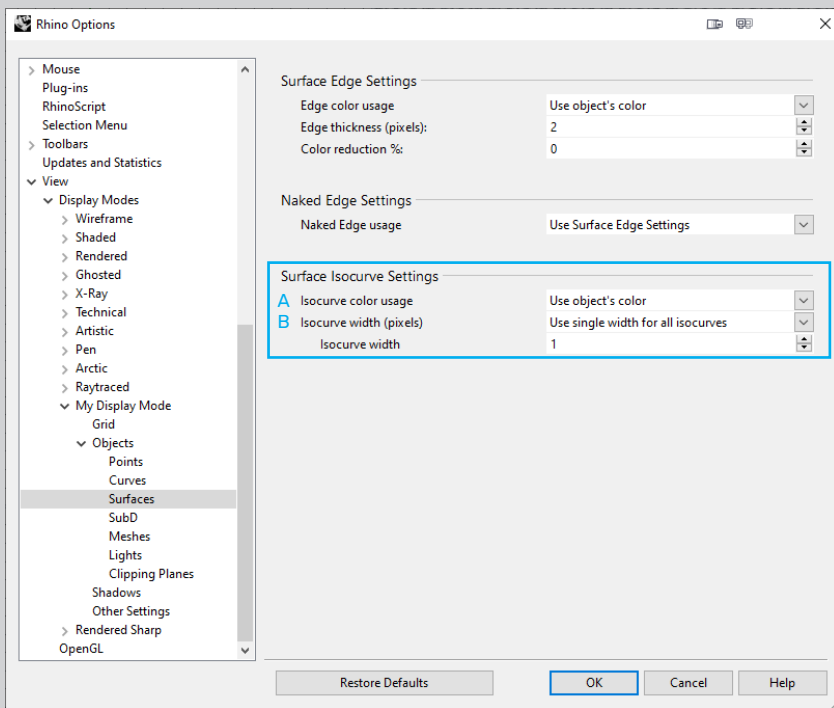


66



67





68 Surface Isocurve Settings

Defines the appearance of Isocurves when using the Display Mode (Fig. 68).

A. Isocurve color usage

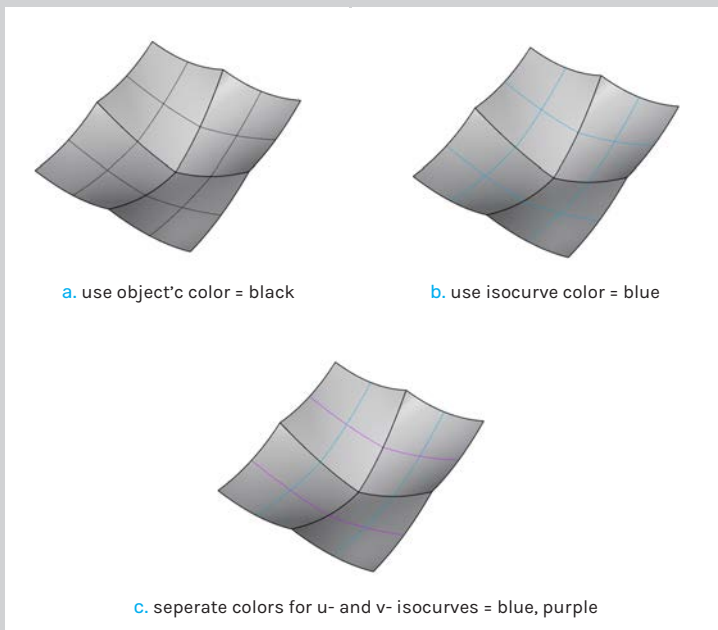
Defines the Isocurves color (Fig. 69).

- a. **Use object's color**
Uses the color defined in the surface object's Properties.
- b. **Use single color for all isocurves**
Sets a custom color for all isocurves.
- c. **Use specified UV colors**
Sets separate colors for u- and v- isocurves.

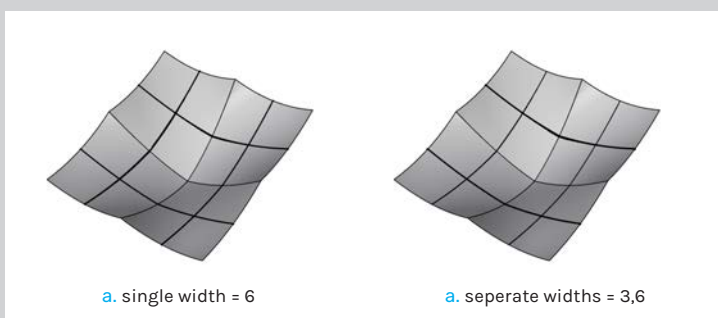
B. Isocurve width (pixels)

Defines the Isocurves width (Fig. 70).

- a. **Use single width for all isocurves**
Sets the width for all isocurves in pixels.
- b. **Use specified UV widths**
Sets separates widths for u- and v- isocurves.



69



70

02 Display Modes

05.04 // SubD

Smooth Wire Settings

Defines the appearance of smooth wires when using the Display Mode (Fig. 71).

71

A. Wire color usage

Defines the wire color (Fig. 72).

a. Use object's color

Uses the color defined in the object's properties for its smooth edges.

b. Use single color for all smooth edges

Sets a custom color for all smooth edges.

B. Wire thickness (pixels)

Sets the smooth edge width in pixels (Fig. 73).

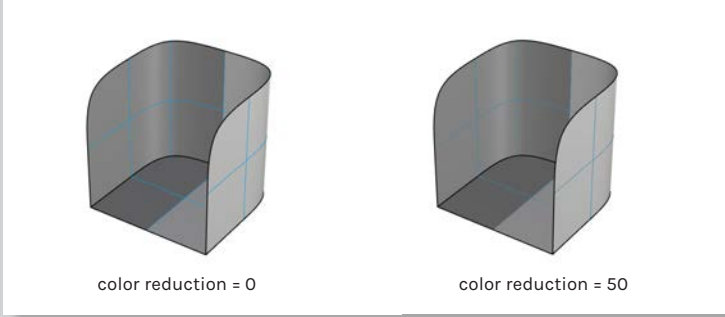
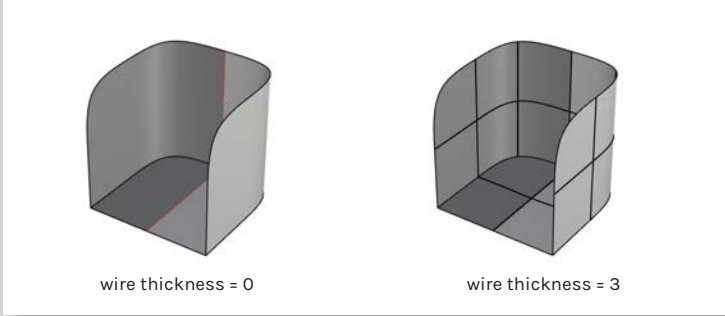
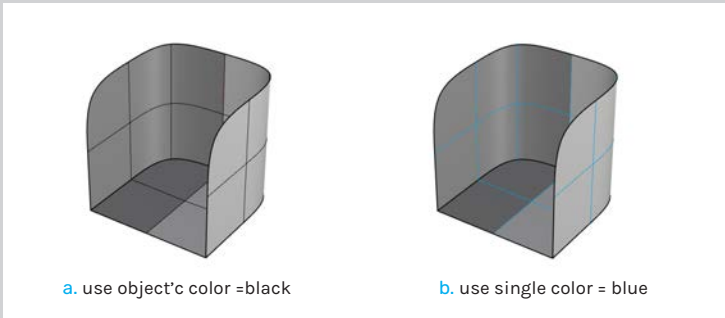
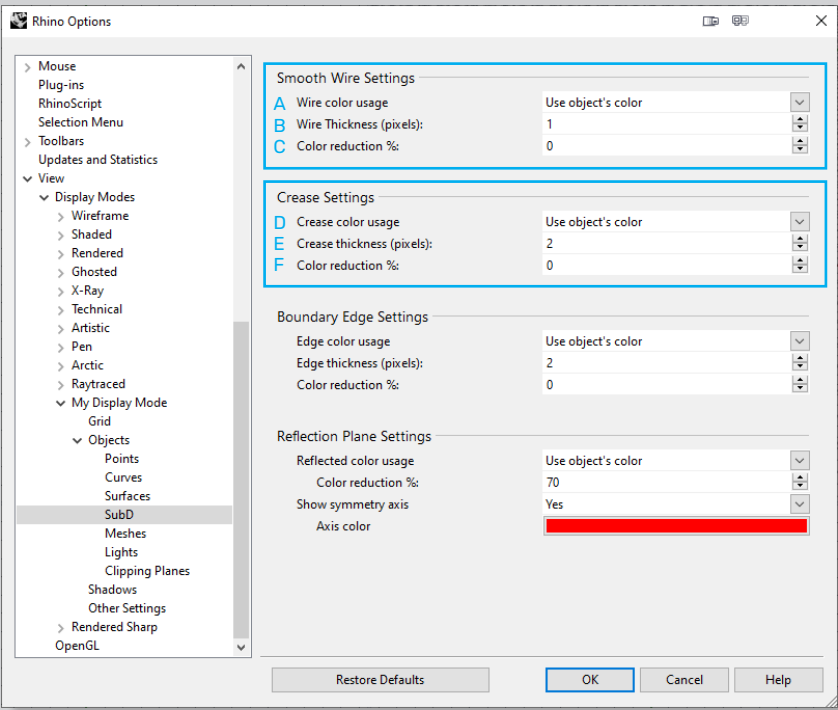
C. Color reduction %

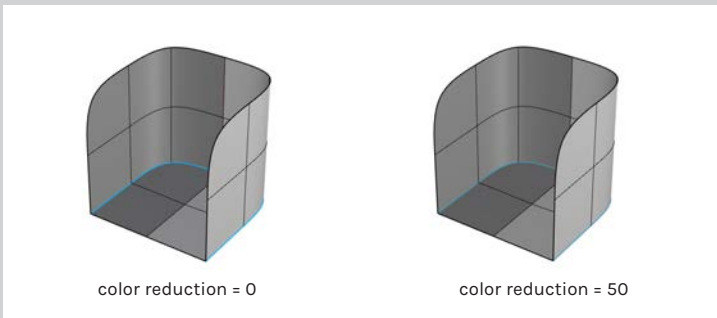
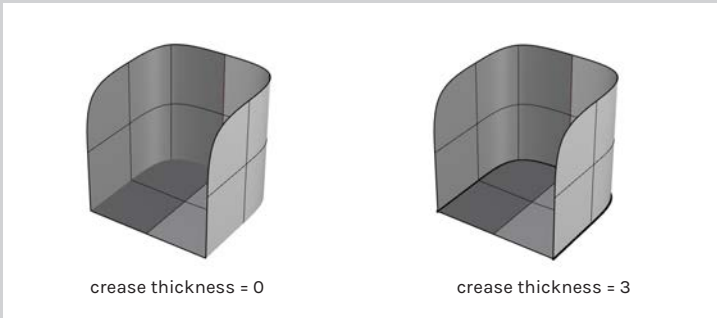
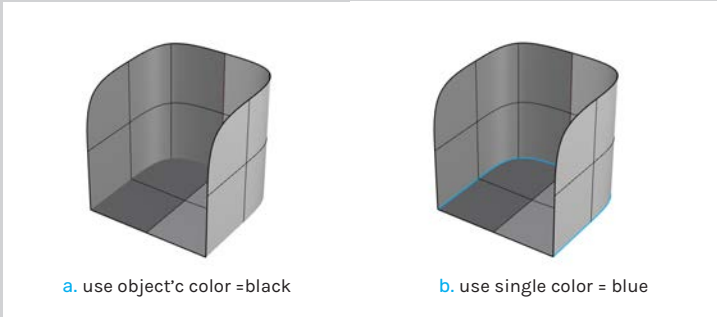
Lightens the smooth edge color by a percentage (Fig. 74).

72

73

74





75 Crease Settings

Defines the appearance of creases when using the Display Mode (Fig. 71).

D. Crease color usage

Defines the Crease color (Fig. 75).

a. Use object's color

Uses the color defined in the object's properties for its creased edges.

b. Use single color for all creases

Sets a custom color for all creased edges.

76

E. Crease thickness (pixels)

Sets the creased edge width in pixels (Fig. 76).

F. Color reduction %

Lightens the creased edge color by a percentage (Fig. 77).

77

02 Display Modes

Boundary Edge Settings

Defines the appearance of boundary edges when using the Display Mode (Fig. 78).

A. Edge color usage

Defines the edge color (Fig. 79).

- a. Use object's color
 - Uses the color defined in the object's properties for its boundary edges.
- b. Use single color for all boundary edges
 - Sets a custom color for all boundary edges.

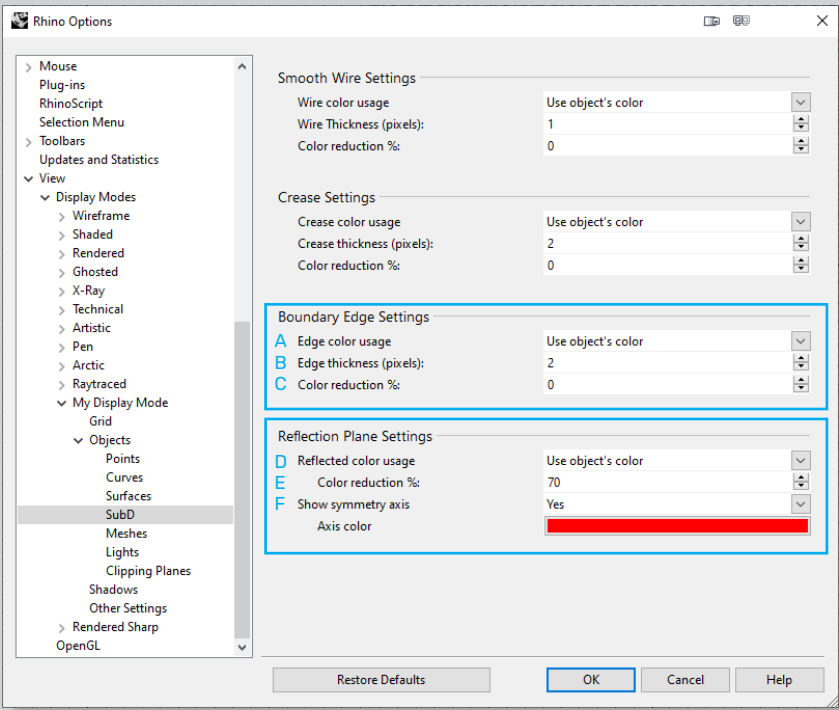
B. Edge thickness (pixels)

Sets the width of boundary edges in pixels (Fig. 80).

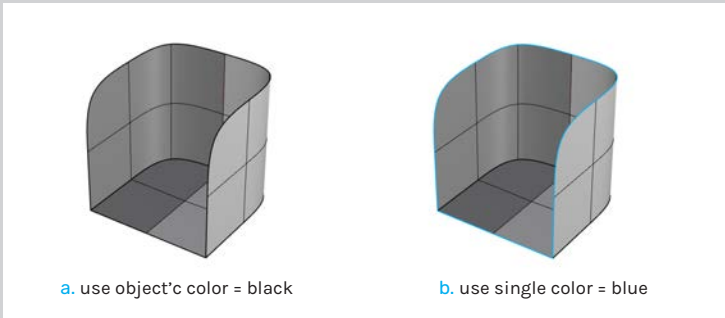
C. Color reduction %

Lightens the color of boundary edges by a percentage (Fig. 81).

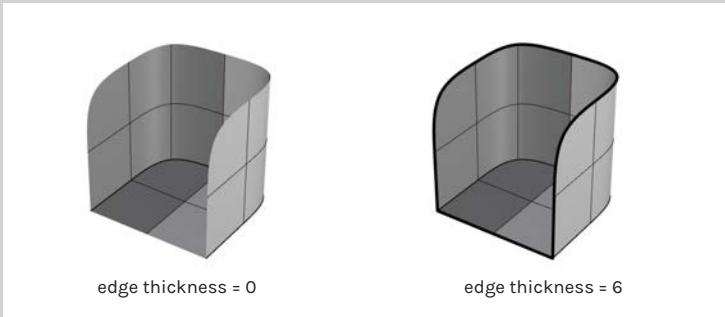
78



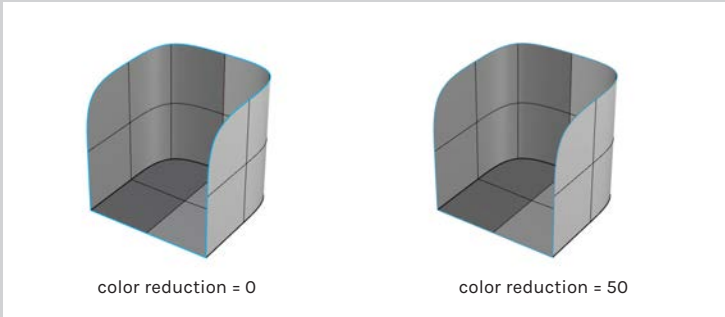
79

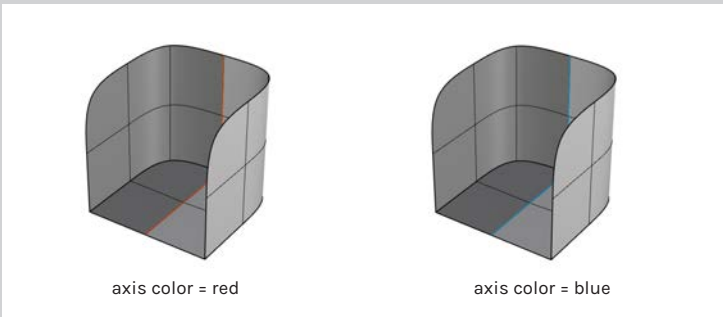
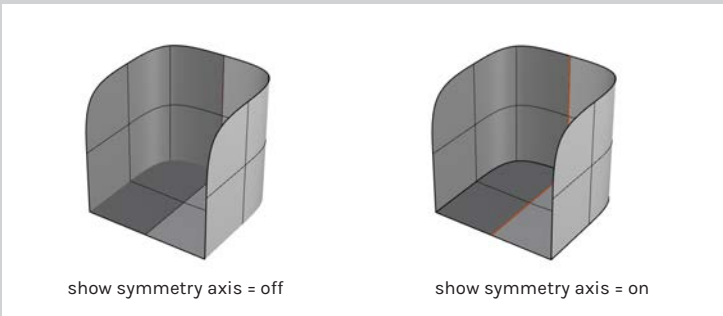
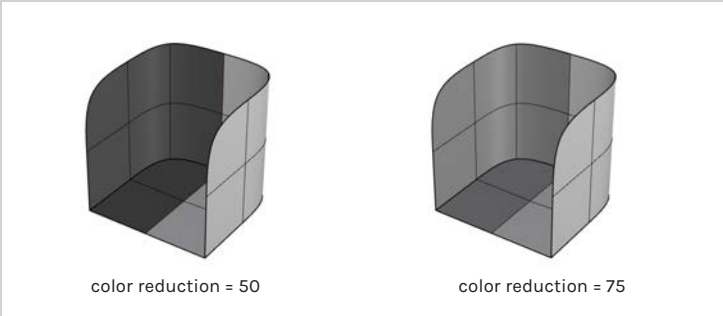
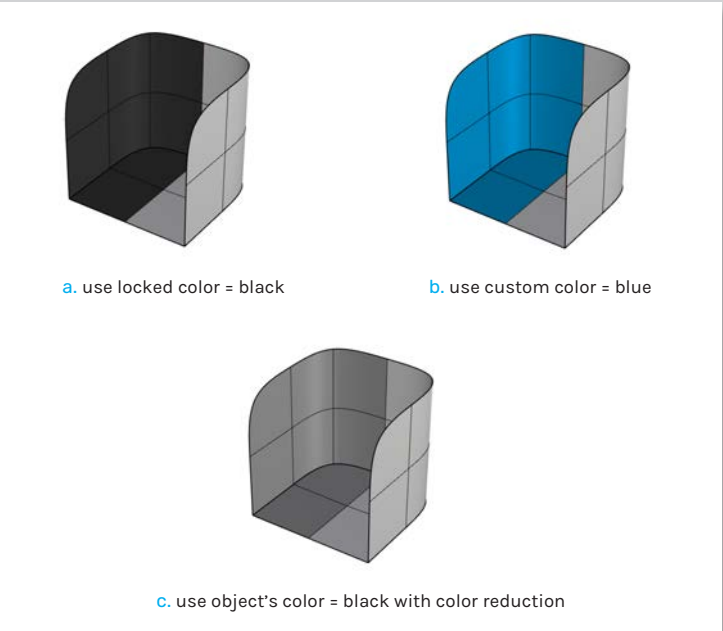


80



81





Reflection Plane Settings

Defines the appearance of the reflection plane when using the Display Mode (Fig. 71).

82

D. Reflected color usage

Defines the reflection plane color (Fig. 82).

a. Use locked color

Uses the locked object color. The locked object color can be changed in the object's properties.

b. Use custom color

Sets a custom color for all reflection planes.

c. Use object's color

Uses the object's display color. The object's display color can be changed in the object's properties.

E. Color reduction %

Lightens the reflection plane color by a percentage (Fig. 83).

83

F. Show symmetry axis

Defines whether the reflection plane section will be displayed (Fig. 84).

G. Axis color

Sets a custom color for the reflection plane axis (Fig. 85).

84

85

02 Display Modes

05.05 // Meshes

Mesh Settings

Defines the appearance of meshes when using the Display Mode (Fig. 86).

A. Wireframe color usage

Defines the Wireframe color (Fig. 87).

- a. Use object's color
 - Uses the color defined in the object's properties.
- b. Use single color for all meshes
 - Sets a custom color for all meshes.

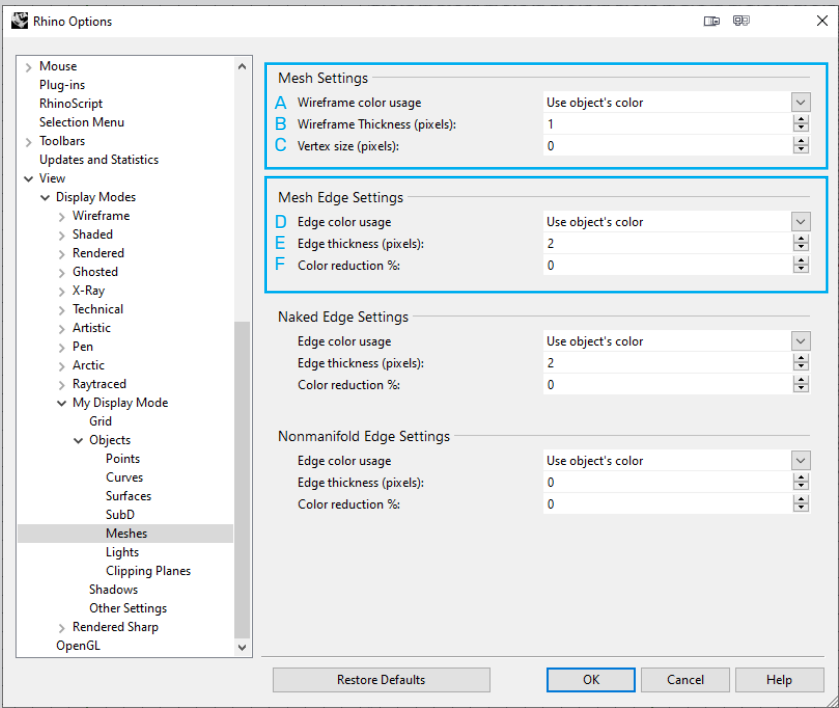
B. Wireframe thickness (pixels)

Sets the wireframe width in pixels (Fig. 88).

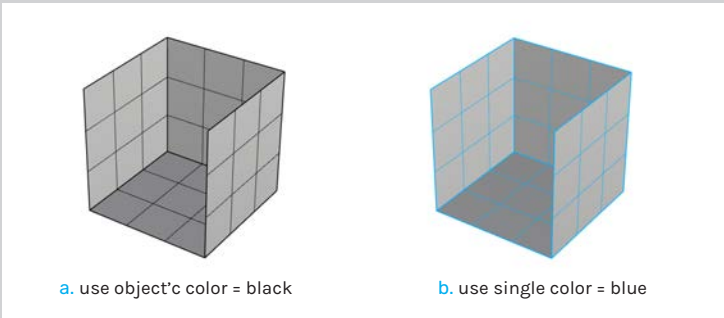
C. Vertex size (pixels)

Sets the vertex size in pixels (Fig. 89).

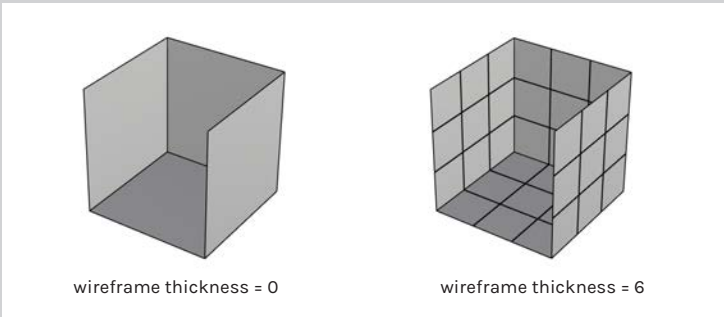
86



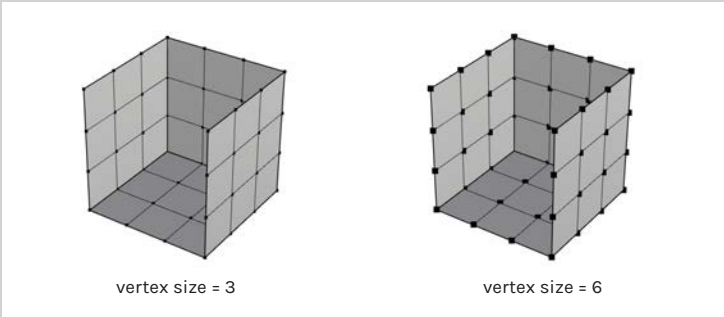
87

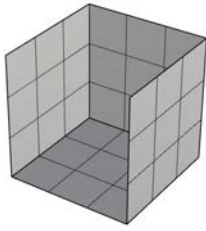


88

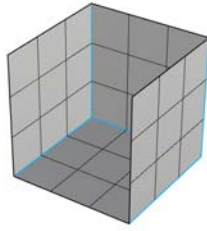


89

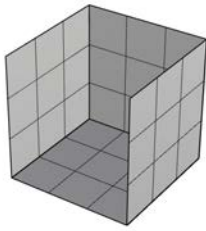




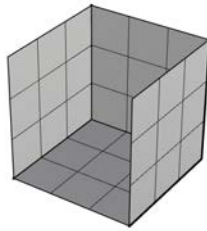
a. use object's color = black



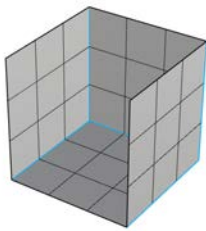
b. use single color = blue



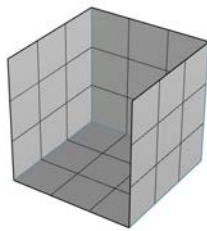
edge thickness = 3



edge thickness = 6



color reduction = 0



color reduction = 75

Mesh Edge Settings

90

Defines the appearance of Mesh Edges when using the Display Mode (Fig. 86).

D. Edge color usage

Defines the Edge color (Fig. 90).

a. Use object's color

Uses the color defined in the object's properties.

b. Use single color for all edges

Sets a custom color for all edges.

91

E. Edge thickness (pixels)

Sets the edge width in pixels (Fig. 91).

F. Color reduction %

Lightens the edge color by a percentage (Fig. 92).

92

02 Display Modes

Naked Edge Settings

Defines the appearance of Naked Edges when using the Display Mode (Fig. 93).

A. Edge color usage

Defines the Naked Edge color (Fig. 94).

- a. Use object's color
 - Uses the color defined in the object's properties.
- b. Use single color for all naked edges
 - Uses a custom color for all naked edges.

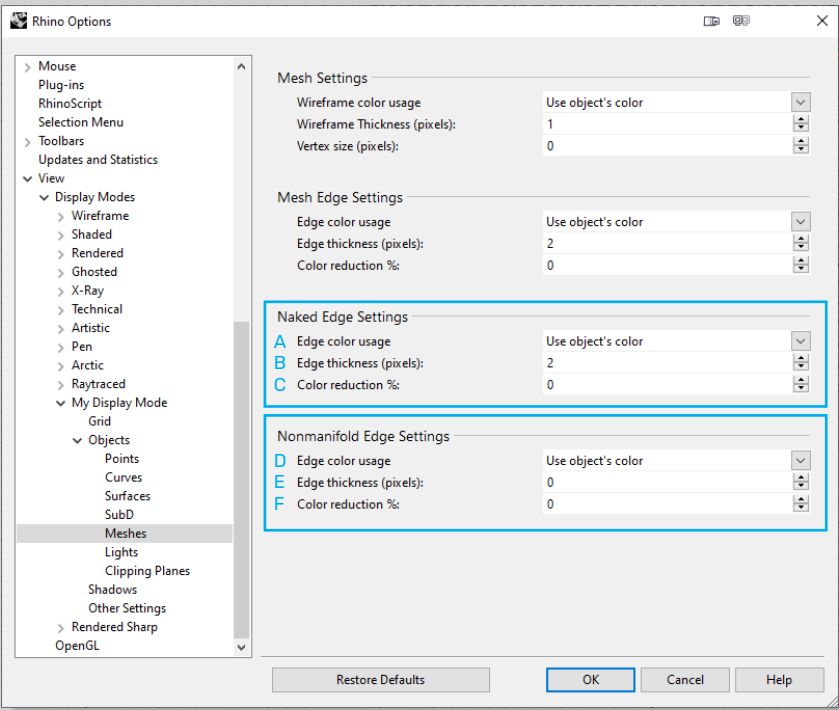
B. Edge thickness (pixels)

Sets the width for all naked edges in pixels (Fig. 95).

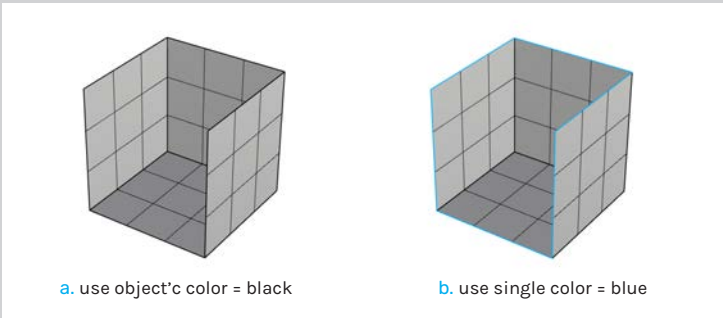
C. Color reduction %

Lightens the color for naked edges by a percentage (Fig. 96).

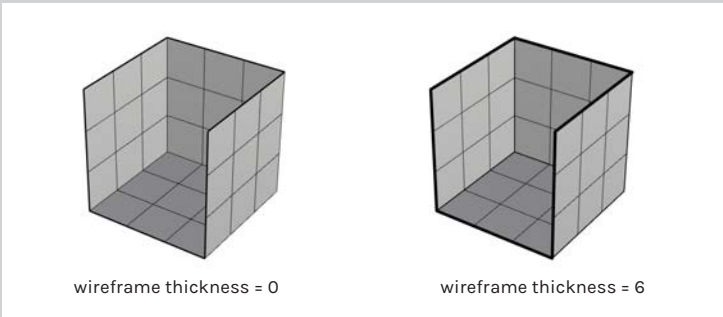
93



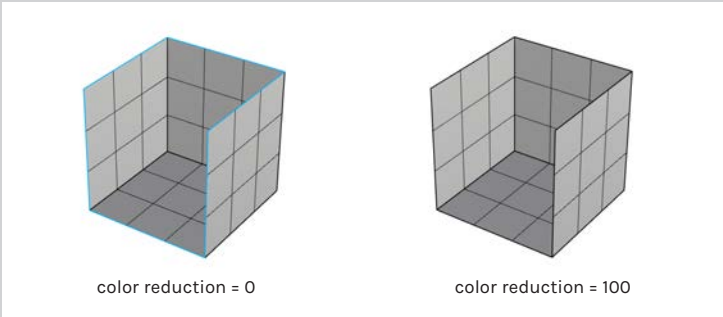
94

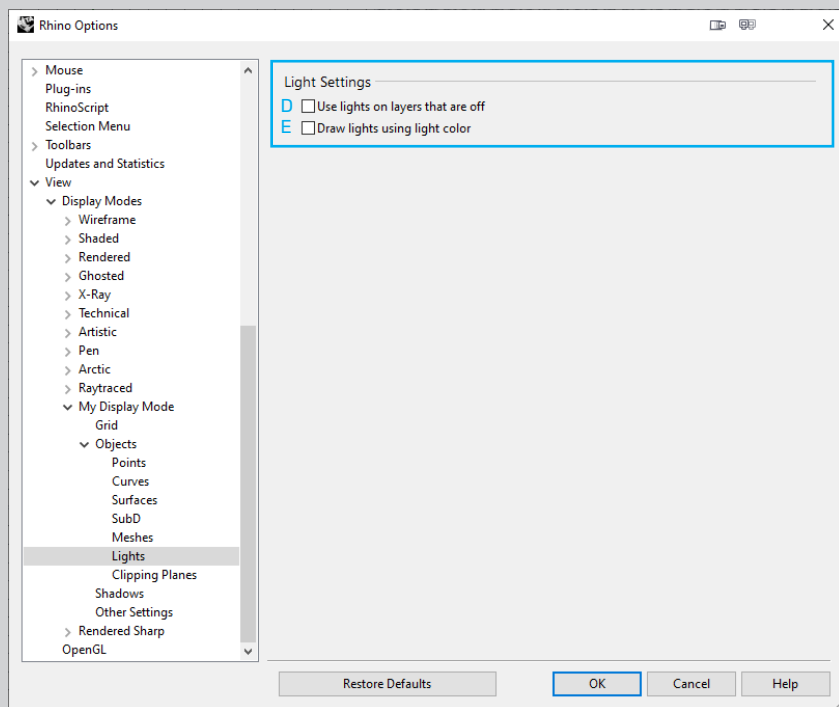


95



96





05.06 // Lights

97

Light Settings

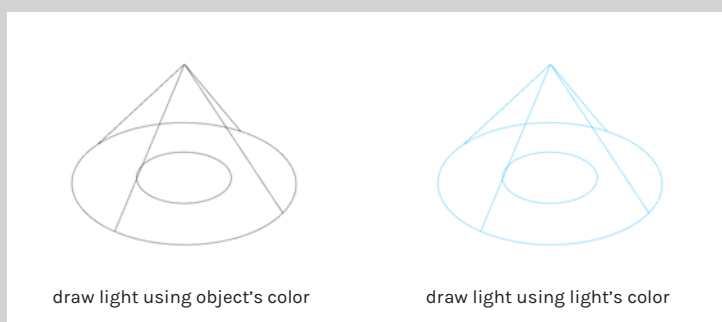
Defines the appearance of lights when using the Display Mode (Fig. 97).

D. Use lights on layers that are off

The settings apply to lights that are on turned-off layers and lights that are hidden.

E. Draw lights using light color

Lights are drawn using the color of the light rather than the color of the light object (Fig. 98).



98

02 Display Modes

05.07 // Clipping Planes

Clipping Plane Settings

Defines the appearance of Clipping Planes when using the Display Mode (Fig. 99).

99

A. Show fills

When the clipping plane intersects a 3D object, the object is displayed filled (Fig. 100).

B. Color usage

Defines the color for the clipped object fill (Fig. 101).

a. Viewport

Uses the viewport background color.

b. Render material

Uses the clipping plane's render material.

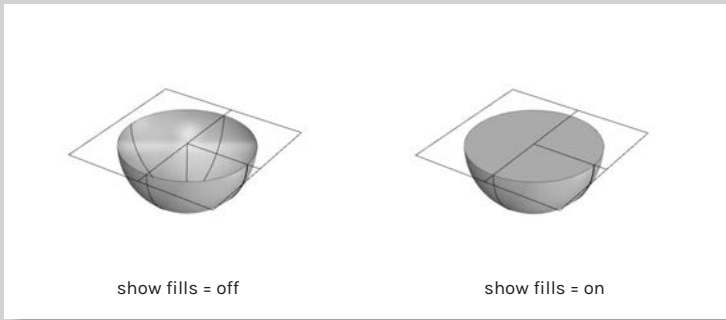
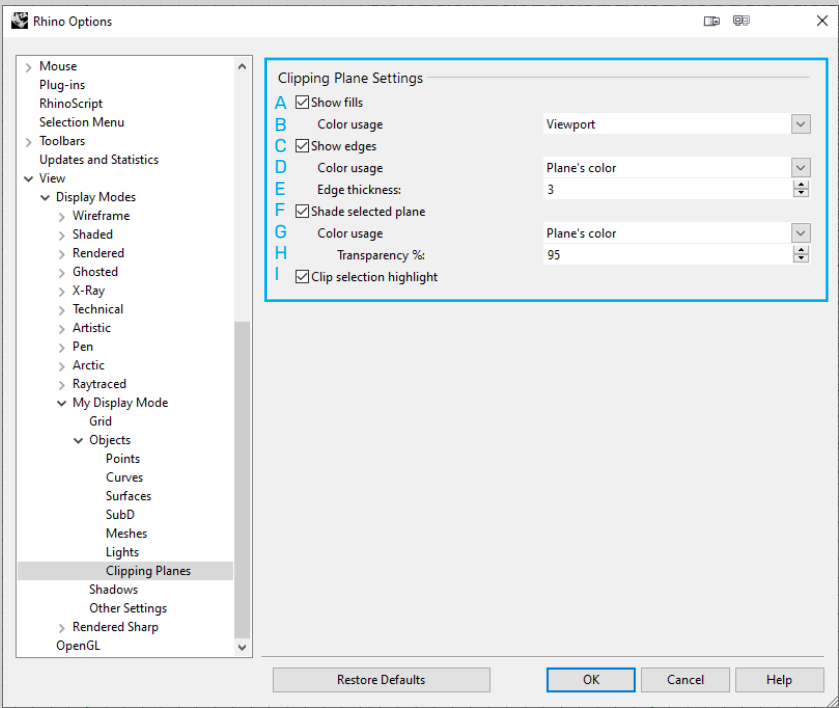
c. Plane's material

Uses the clipping plane's object color.

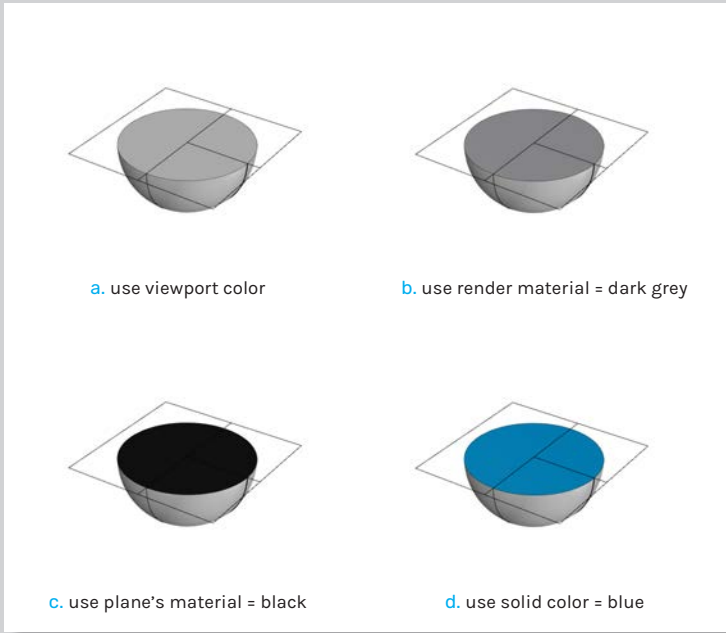
d. Solid color

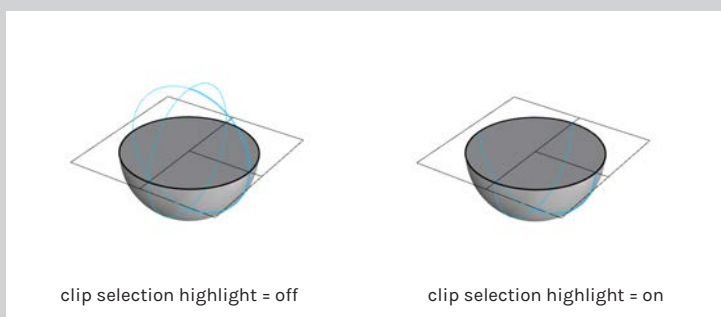
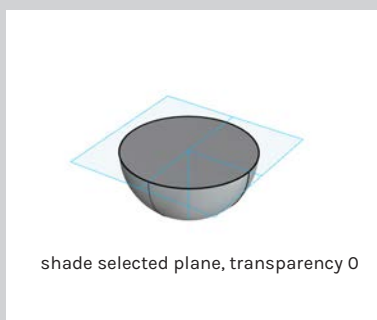
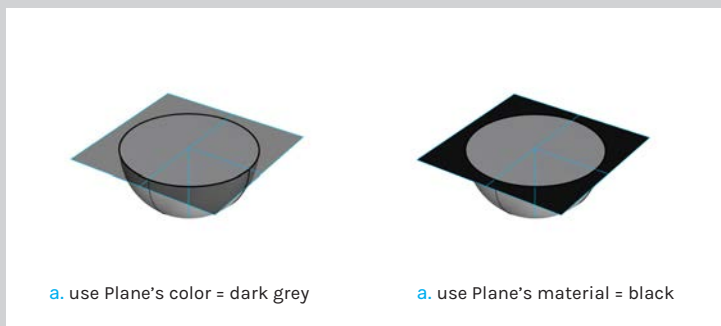
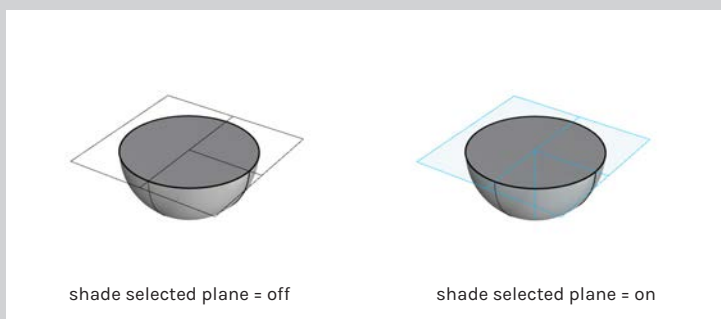
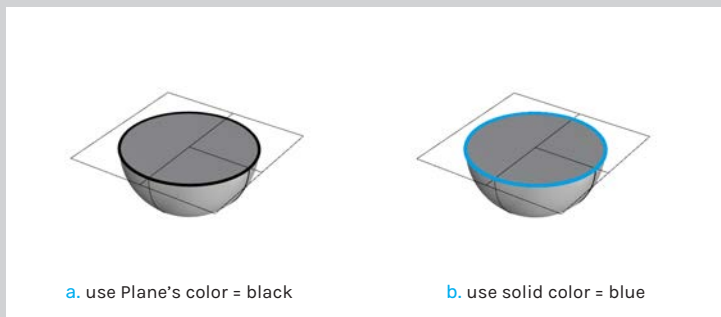
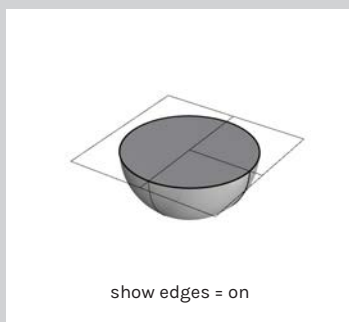
Sets a custom color for the fill.

100



101





102

C. Show edges

Shows the edge between the clipping plane and the clipped object (Fig. 102).

D. Color usage

Defines the clipped edge color (Fig. 103).

a. Plane's color

Uses the clipping plane's color for its edges.

103

b. Solid color

Sets a custom color for the clipping planes edges.

E. Edge thickness

Sets the width of the clipping plane edges in pixels (Fig. 102).

F. Shade selected plane

Shades the selected clipping plane (Fig. 104).

104

G. Color usage

Defines the Clipping Plane color (Fig. 103).

a. Plane's color

Uses the clipping plane's color for shading.

b. Plane's material

Uses the clipping plane's render material for shading.

105

c. Solid color

Uses a custom color for shading.

H. Transparency %

Sets the transparency of the selected plane (Fig. 106).

I. Clip selection highlight

Clips the highlighted wires. Shaded selection always clip (Fig. 107).

106

107

02 Display Modes

06 // Shadows

Shadow Settings

Defines the appearance of Shadows when using the Display Mode (Fig. 108).

A. Shadows on

Turns shadows on if checked. Turn on the ground plane under the Display mode options to make it receive shadows (Fig. 109).

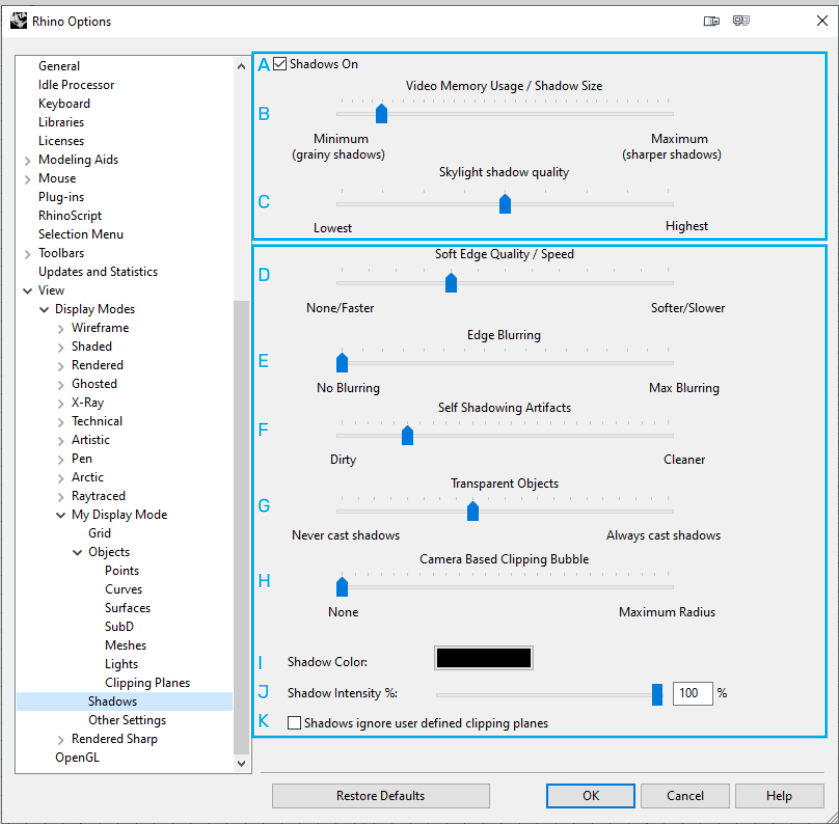
B. Video Memory Usage / Shadow Size

Balances between grainy and sharper shadows (Fig. 110).

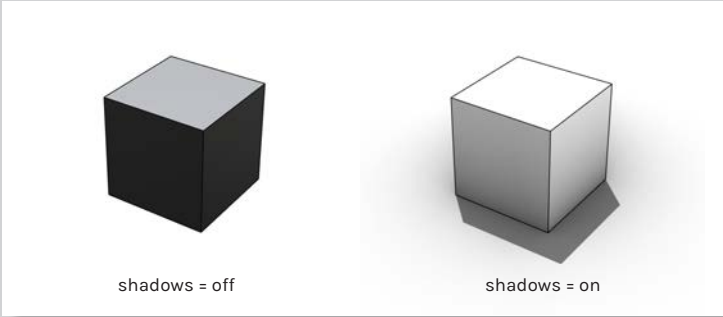
C. Skylight shadow quality

Balances the skylight shadow quality. The skylight can be turned on in the render settings (Fig. 111).

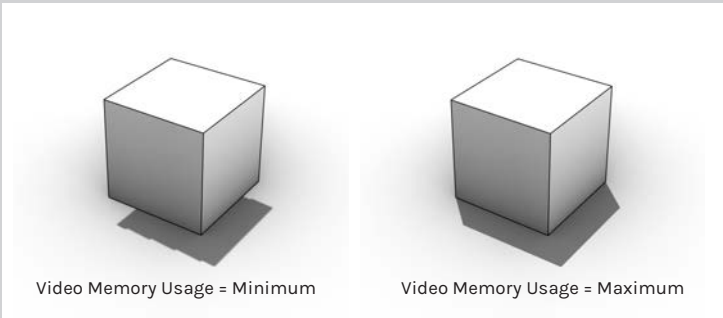
108



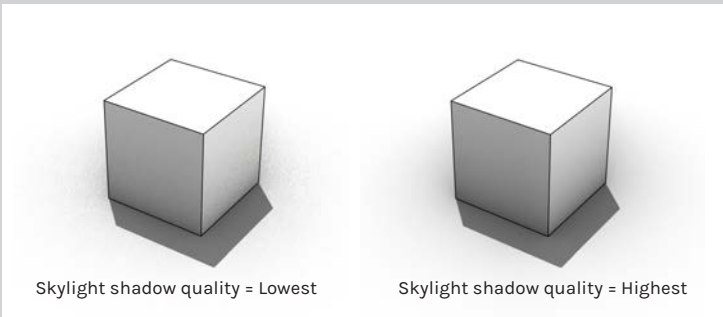
109

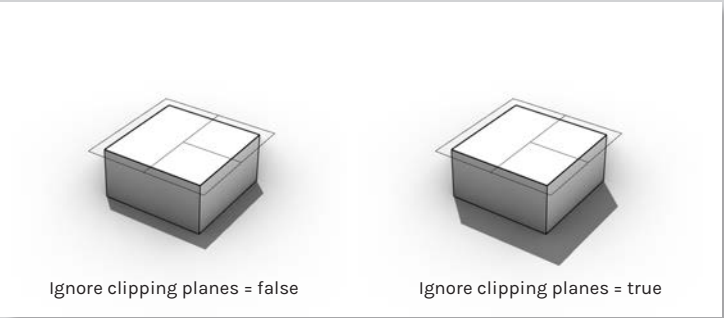
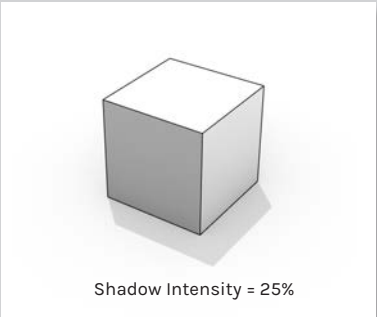
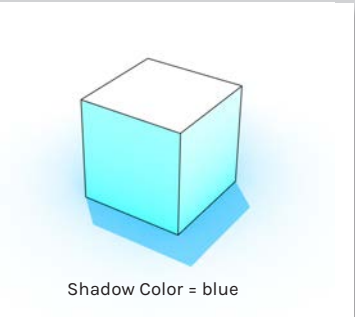
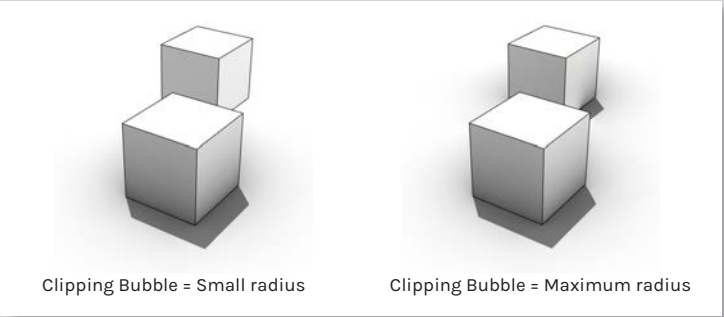
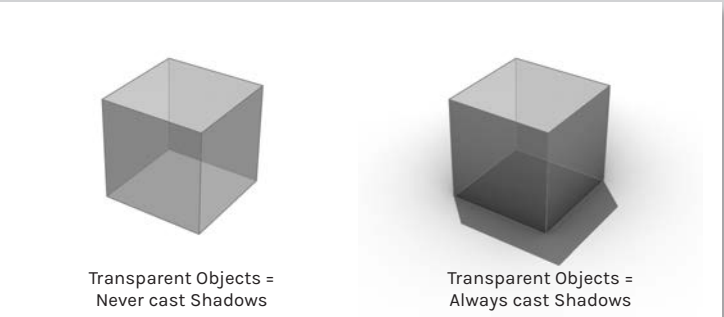
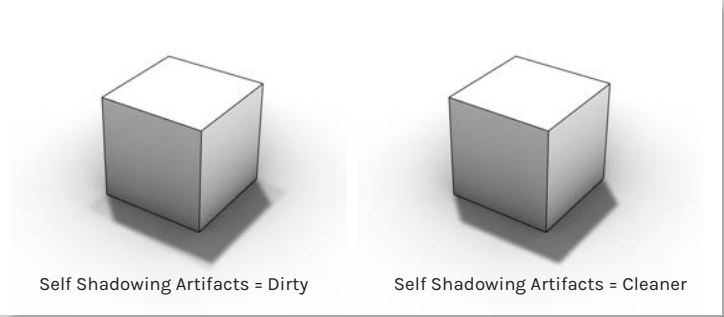
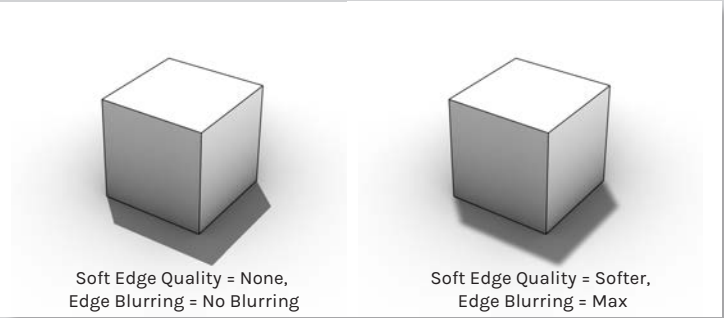


110



111





112

D. Soft Edge Quality / Speed

Balances between sharp and soft shadows.

Slower shadows are slower calculated (Fig. 112).

E. Edge Blurring

Blurs the shadow edges (Fig. 112).

113

F. Self Shadowing Artifacts

Balances between dirty and clean shadows.

Dirty shadows may work well in complex scenes (Fig. 113).

G. Transparent Objects

Sets the shadow intensity for transparent objects (Fig. 114).

H. Camera Based Clipping Bubble

114

Sets the camera clipping distance. Objects not within its borders won't cast a shadow. (Fig. 115).

I. Shadow Color

Sets the shadow color (Fig. 115).

J. Shadow Intensity %

Sets the shadow intensity (Fig. 116).

115

K. Shadows ignore user defined clipping planes

Specifies whether shadows should ignore user defined clipping planes (Fig. 117).

116

117

02 Display Modes

07 // Other Settings

118

User Interface Options

Defines partly the appearance of the UI when using the Display Mode (Fig. 118).

- A. Include in View's display mode menu**
Displays the custom display mode in the view-port title and view menus.
- B. Include in Shade command modes**
Offers the custom display mode as an option for the "Shade", "SetDisplayMode" and "DisplayMode" command.
- C. Allow assignment to individual objects**
Allows applying this display mode to objects with the "SetObjectsDisplayMode" command.

View Scaling

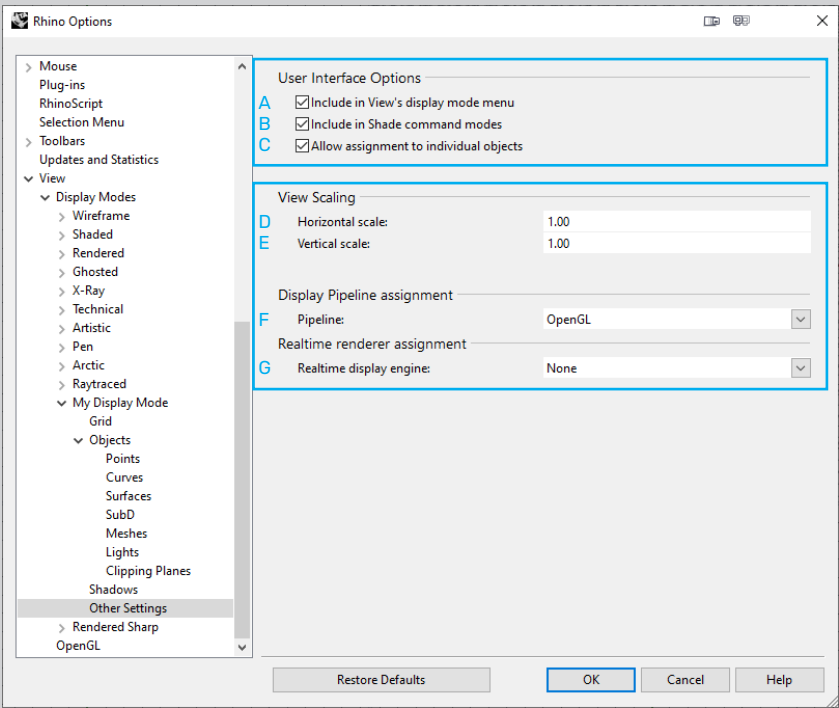
- A. Horizontal Scale**
Distorts the view and grid horizontally.
- B. Vertical Scale**
Distorts the view and grid vertically.

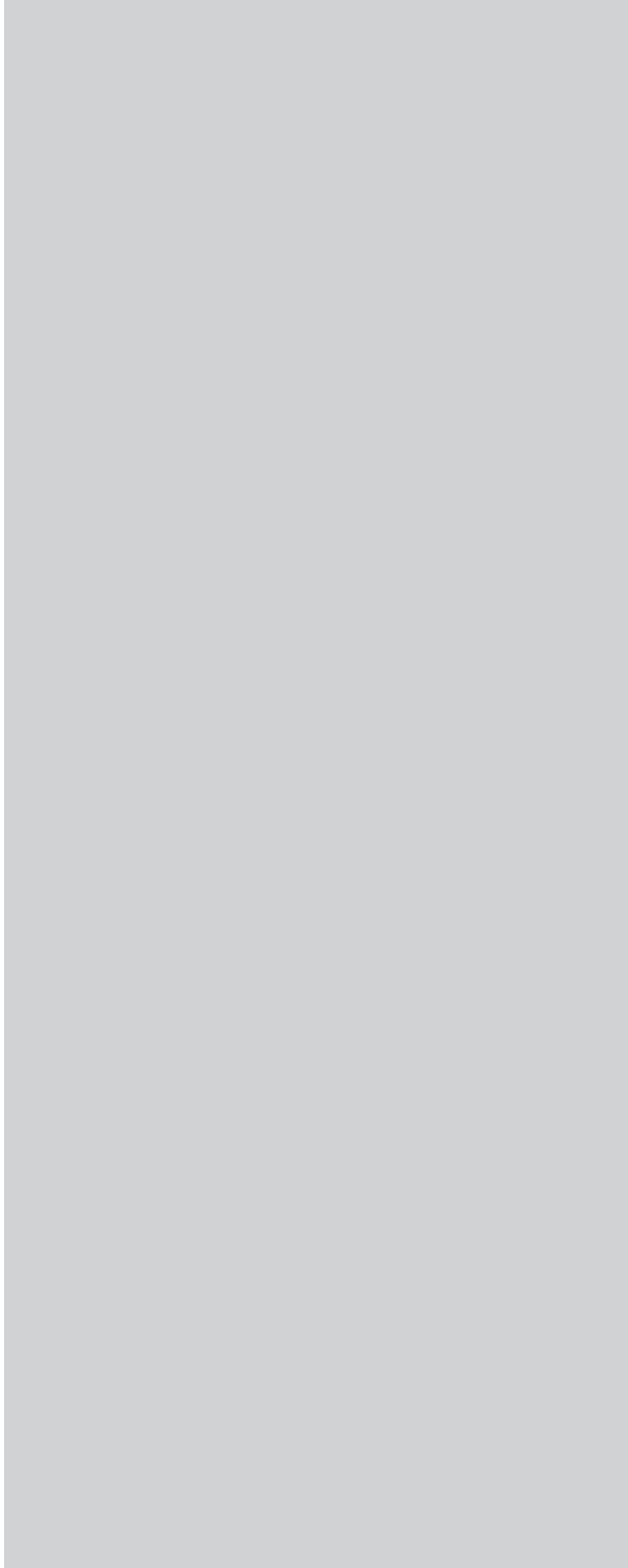
Display Pipeline assignment

- A. Pipeline**
The display pipeline handles all the drawing of viewports - wireframe, shaded, ghosted, etc.
The drawing is either handled by Windows or by an OpenGL supporting graphic cards.

Realtime renderer assignment

- A. Realtime display engine**
Sets the rendering engine. By default, only Cycles will be available. However, also other rendering engines can be acquired commercially for Rhino.





Chapter 03

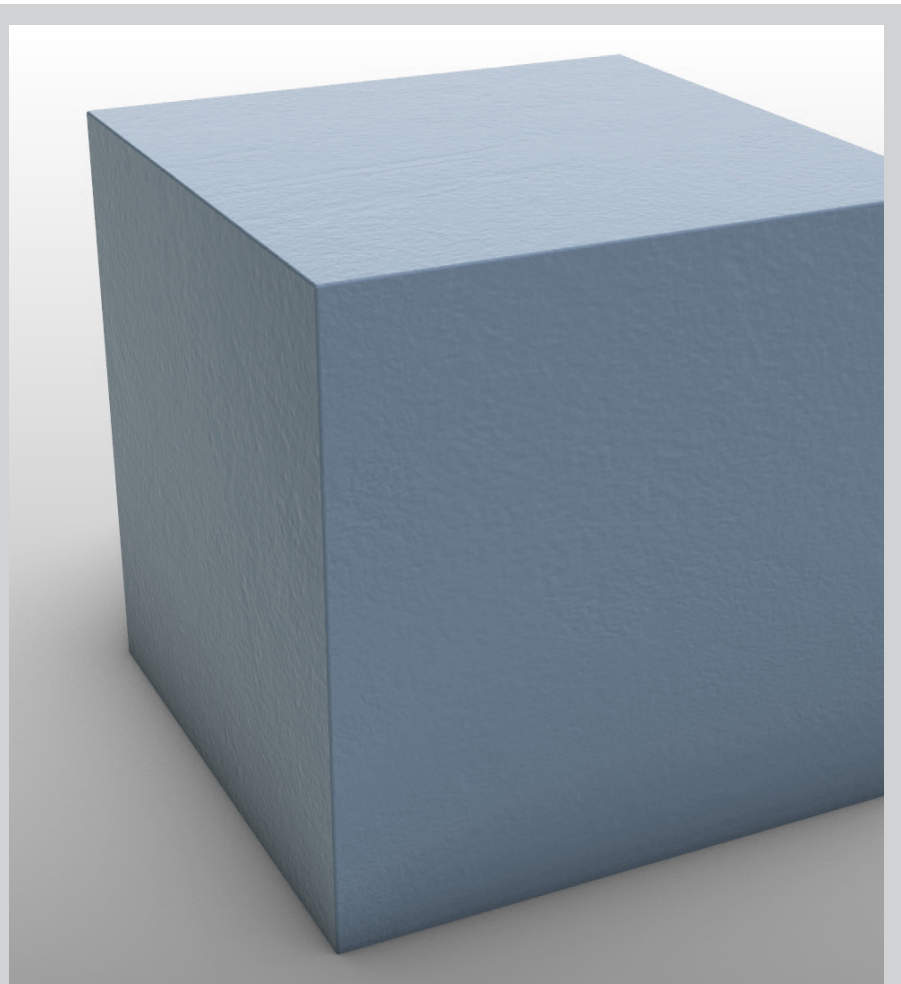
- 01 Overview
- 02 Light settings
- 03 Material settings
- 04 Environment settings
- 05 Ground plane settings

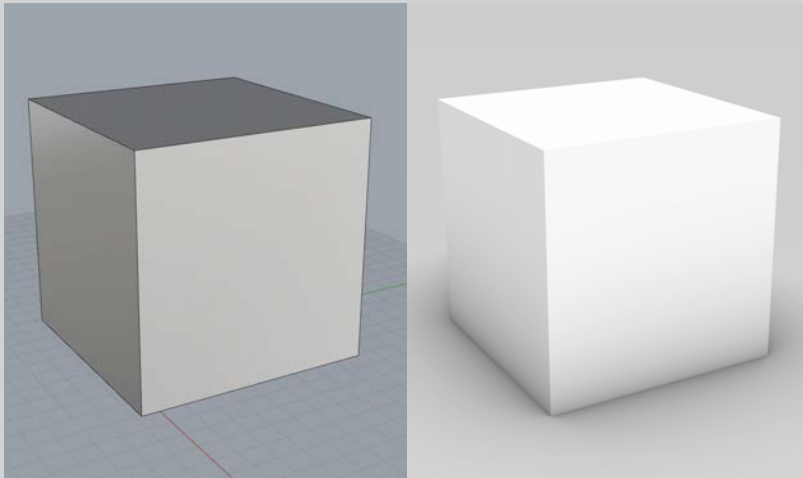
01 // Overview

What is Rendering?

The Rendered Display Mode offers the user to adjust various settings other display modes do not - such as materiality and lighting. These parameters can be set and adjusted in the panels menu ([Fig. 01](#)).

01





Basic steps

The rendering process essentially consists of a few steps, which should be followed:

02

- A. Define lighting
- B. Add materials
- C. Environment and ground plane setup
- D. Execution of the rendering

The following of a fixed workflow is an ideal way to produce a high-quality result and to work efficiently (Fig. 02).

02 // Light settings

03

Lights

Rendering has light sources that are responsible for how an object or scene is illuminated. A standard lighting is preset in both rendered and retraced display mode from the beginning. This can be changed, replaced, or modified with additional lights.

There are mainly three different types of lights in Rhino:

- A. Sun
- B. Skylight
- C. Directional lighting (spotlights, directional lights, linear lights, point lights, or rectangular lights).

04

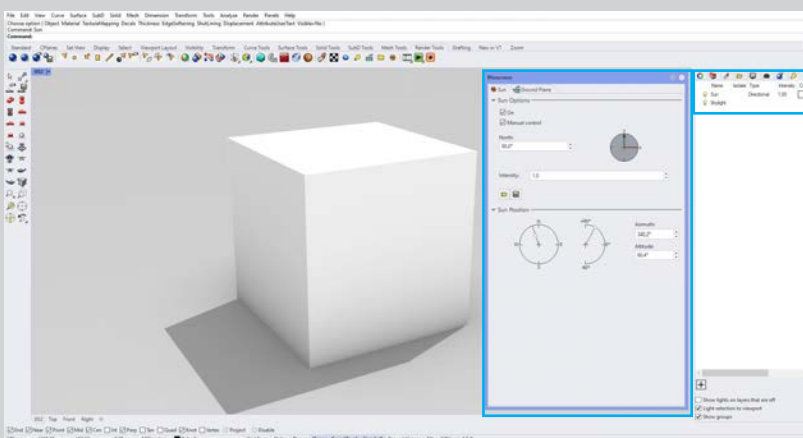
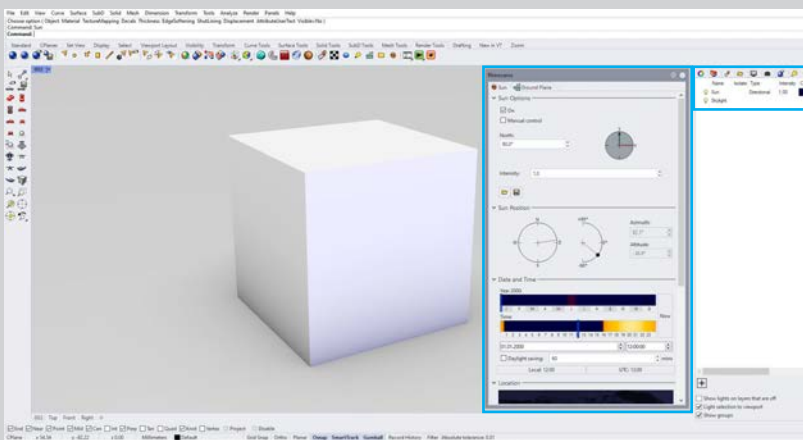
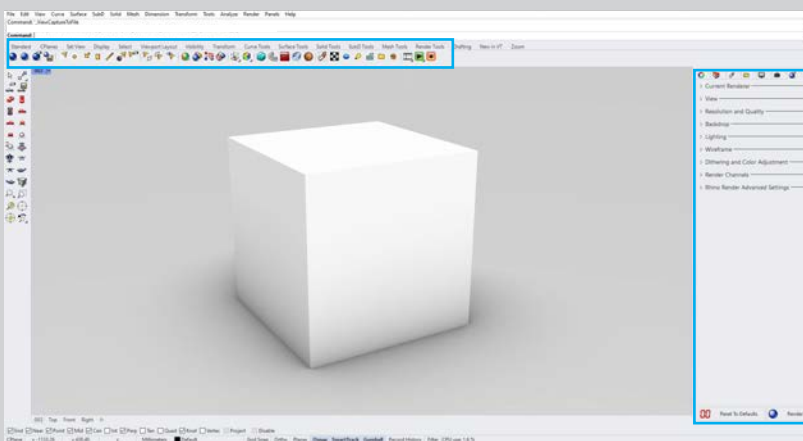
The settings for lights can be found in the render panel under the item lights (Fig. 03).

One option for lighting the scene is the _Sunlight. Here, you can adjust the location of the sun as well as the direction in order to adjust both the light temperature and the shadow projection.

In this case, the skylight is additionally activated to achieve a better result (Fig. 04).

05

If you tick the box for manual control, you will be able to manually adjust the incidence of the sun by moving the handles (Fig. 05).



03 Rendering

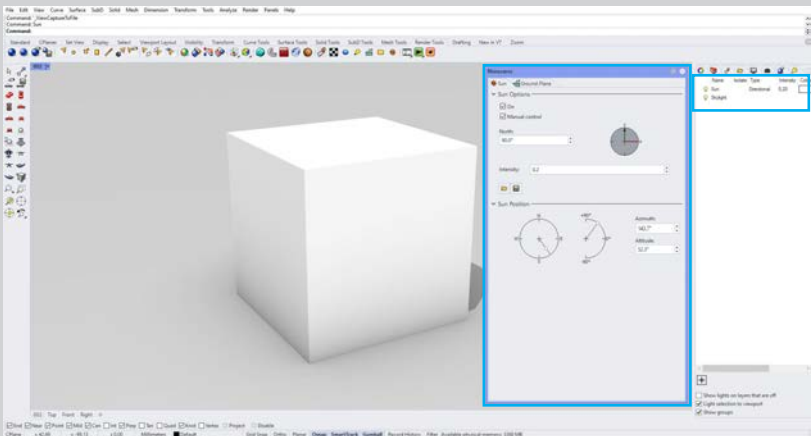
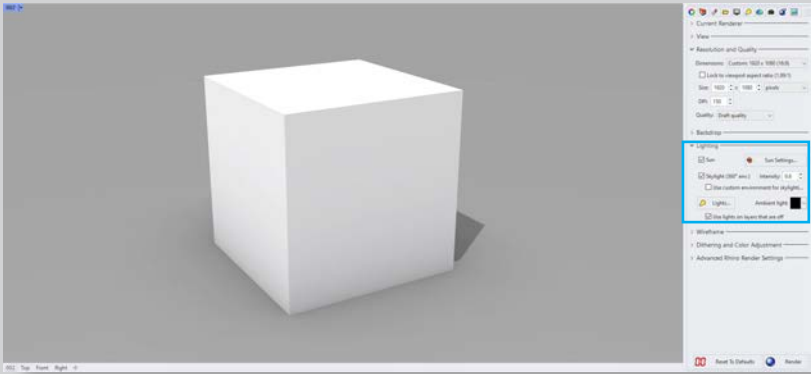
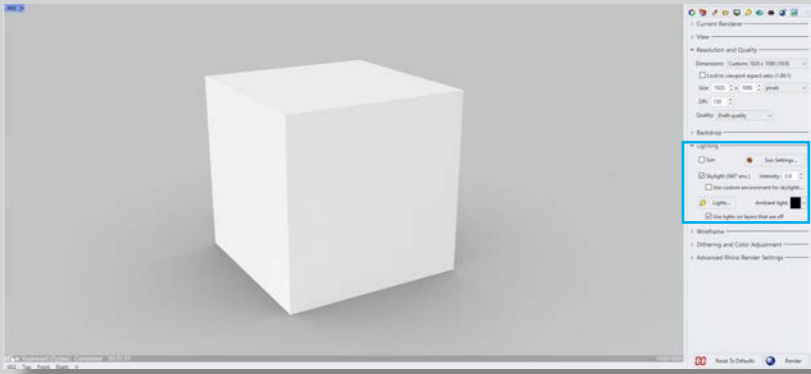
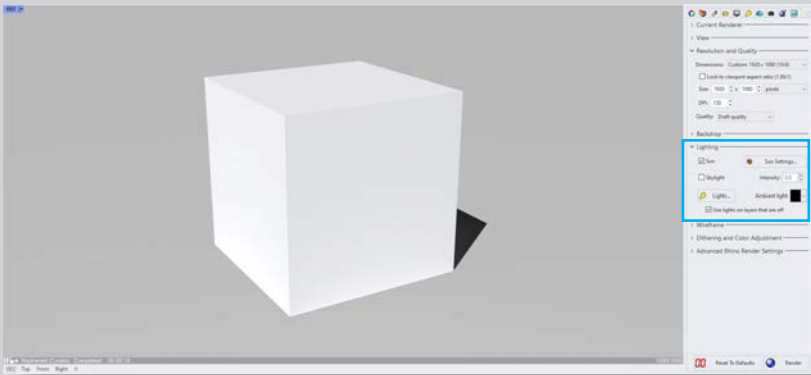
Raytraced display mode

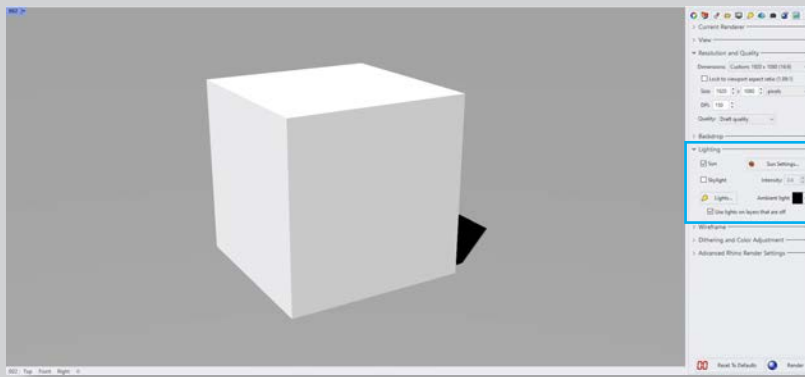
Raytraced Display Mode - Sun selected. If only the sun is selected, a hard ground shade is a result (Fig. 06).

Raytraced Display Mode - Sky selected. If only the skylight is selected, a very soft ground shade is the result (Fig. 07).

RaytracedDisplayMode-Sky&Sunselected.Inthis case, the characteristics of both light sources are visible (Fig. 08).

When both the Sun and the Skylight are switched on, make sure that the intensity of both light sources is reduced to avoid overexposure (Fig. 09).





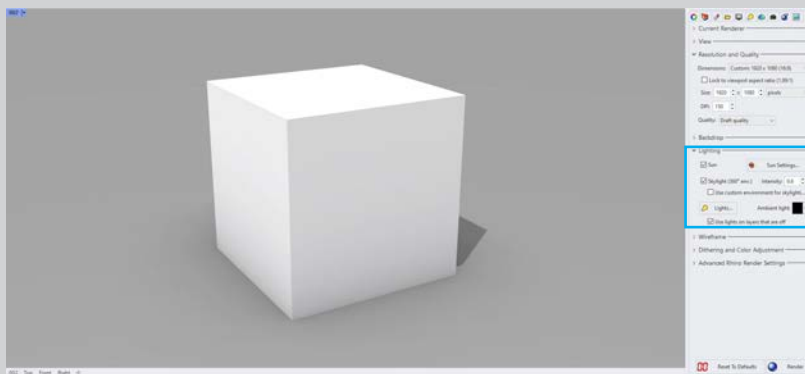
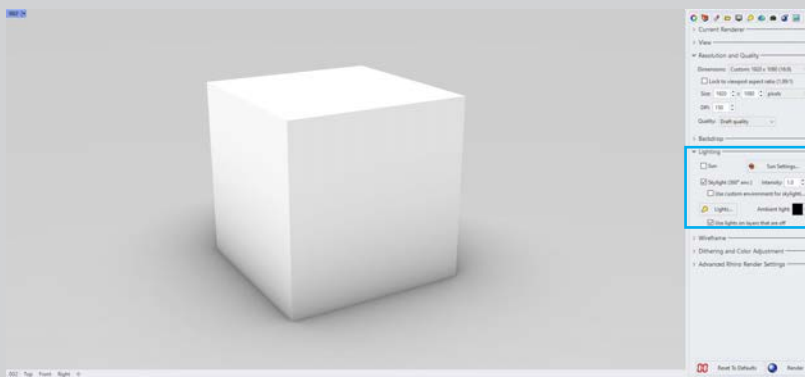
Rendered display mode

The same conditions apply to the appearance and characteristics of the respective light sources as for light sources in raytraced display mode.

Rendered Display Mode - Sun selected (Fig. 10).

Rendered Display Mode - Sky selected (Fig. 11).

Rendered Display Mode - Sky & Sun selected (Fig. 12).



03 Rendering

Directional lighting

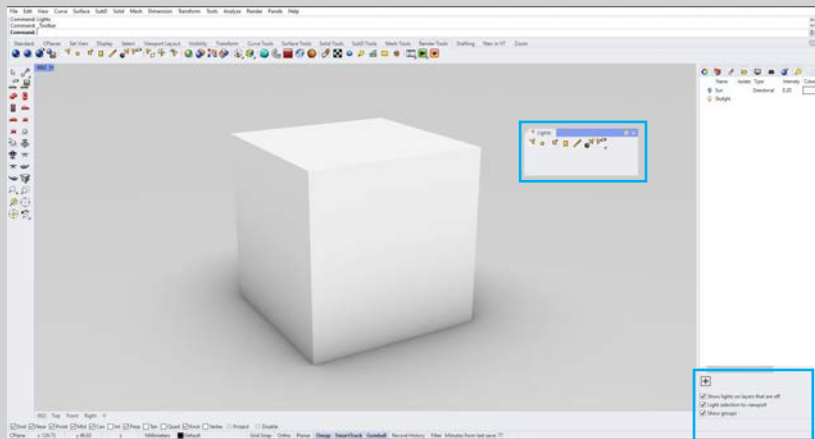
Another way to illuminate the scene is to selectively generate additional light sources - such as a spotlights, directional lights, linear lights, point lights, or rectangular lights (Fig. 13).

This makes it possible to create an active light to highlight a scene or an object (Fig. 14).

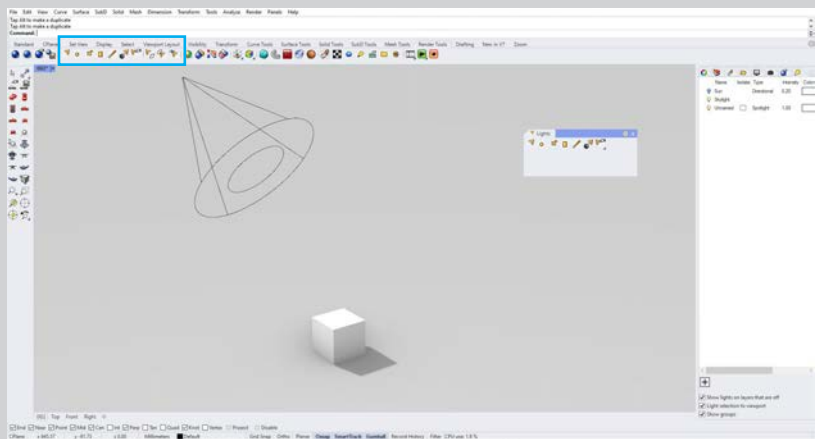
- A. Spotlight
- B. Point light
- C. Directional light
- D. Rectangular light
- E. Linear light

(Fig. 15)

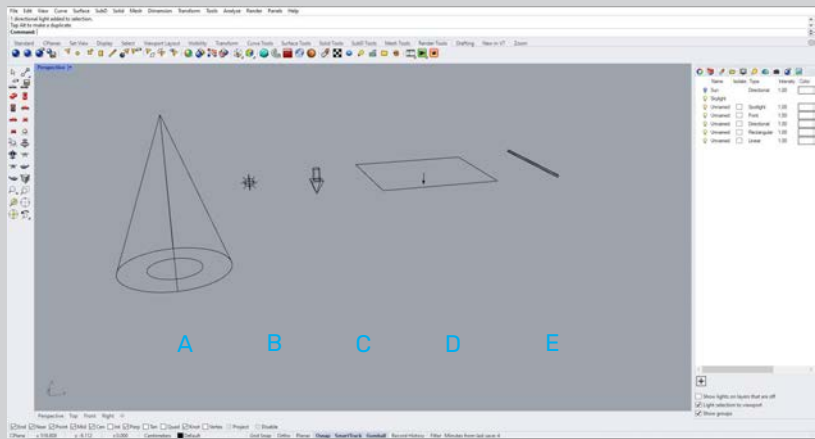
13



14



15



03 // Material settings

Materials

13 Materials specify the color, finish, transparency, texture, and bump for use by the renderer. Rhino offers a large material library with different material groups, as well as the possibility to edit materials, create new ones or import them.

Within the material panel, you can configure settings for e.g. color, texture and bump, transparency, and finish.

Existing material groups include:

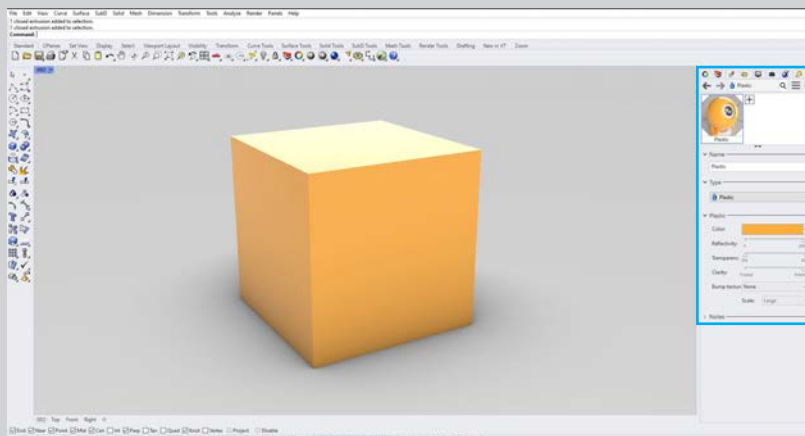
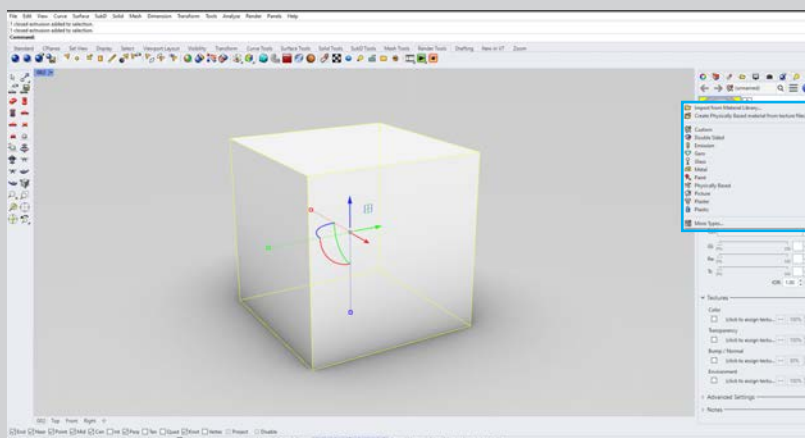
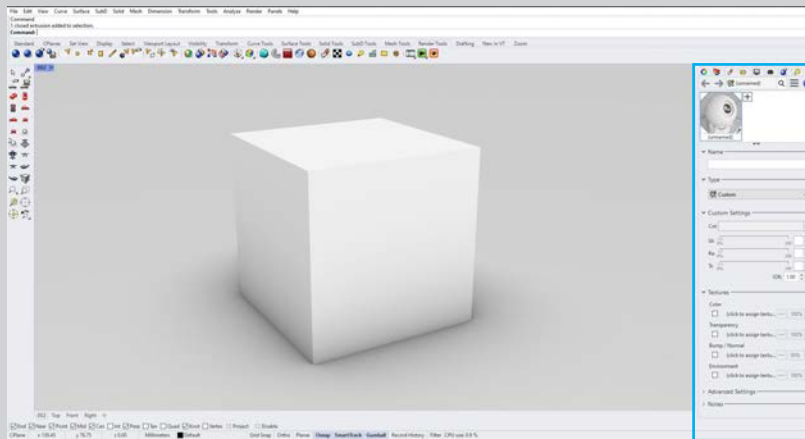
- Custom material
- Glass
- Metal
- Paint
- Picture
- Plaster
- Plastic
- Gem

There are various ways to apply a material to an object. One option is to use the material panel in the sidebar or via the menu (Fig. 13).

To add material to an object, it must first be selected.

15 The material can then be transferred to the object either via properties or by selecting the materials panel in the sidebar/toolbar (Fig. 14).

Using the materials menu, you can then select a material from the library or import it from another folder (Fig. 15).



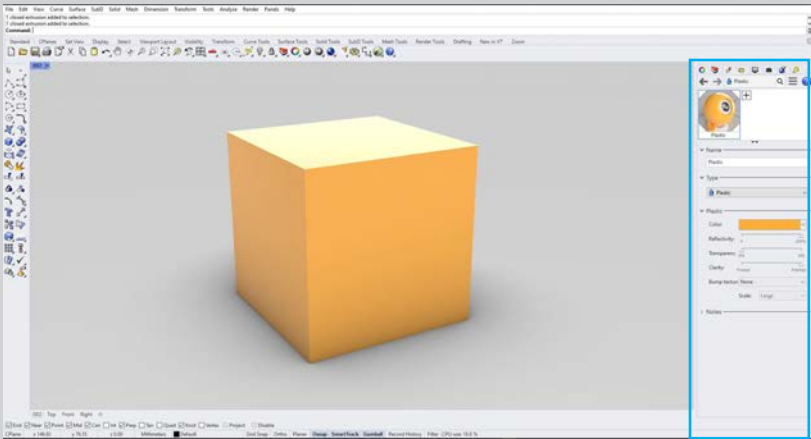
03 Rendering

In Rendered and Raytraced mode you can see the materiality on the object. A preview of the material is shown in the Sidebar as well as the possible settings, which vary depending on the type of material (Fig. 16).

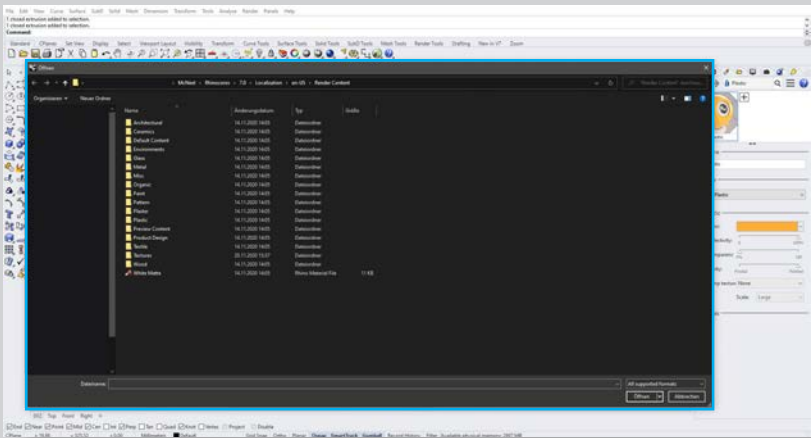
The materials can also be imported - this is as well possible via the sidebar (Fig. 17).

Preview options are also available in the browser before selecting the material (Fig. 18).

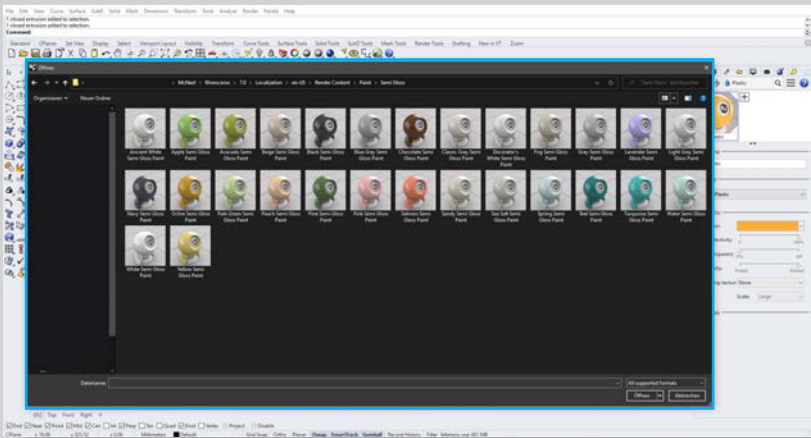
16

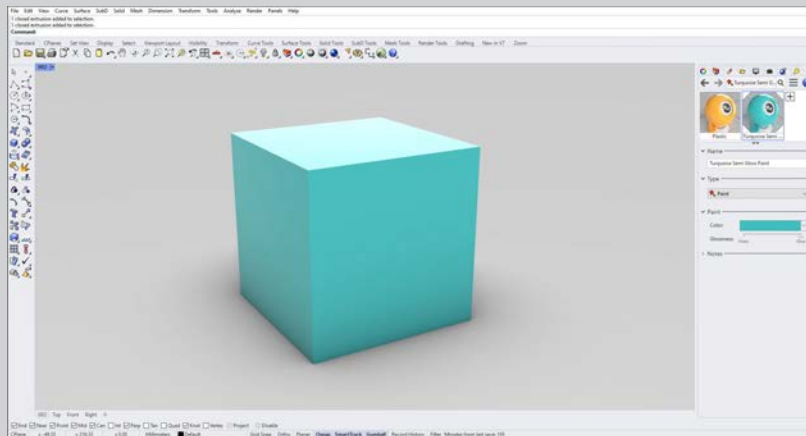


17



18



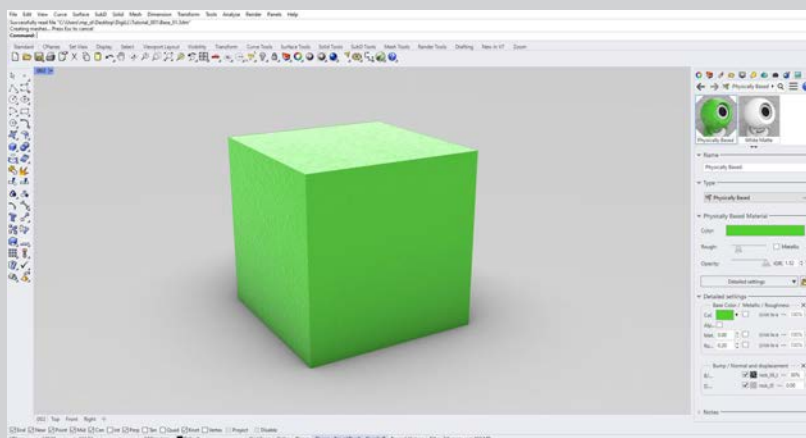


The imported material can, for example, easily be transferred onto the object by drag and drop (Fig. 19).

19

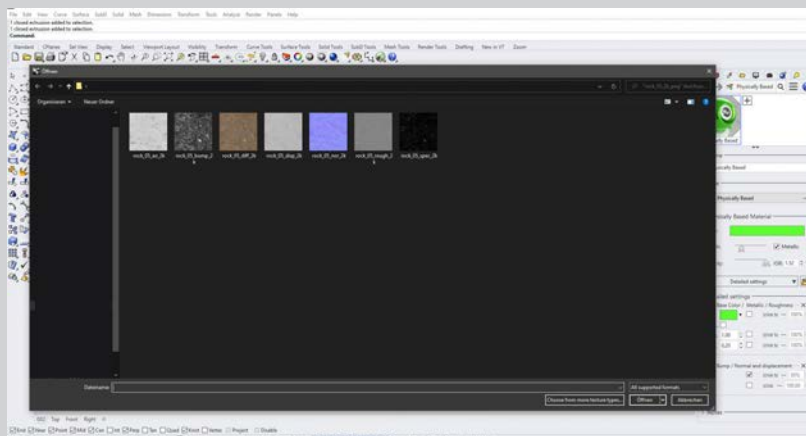
Rhino now also supports physically based rendering (PBR) materials according to industry standards. Herewith it is possible to produce physically correct and very high-quality materials. Since PBR materials are used across platforms, there is a huge number of materials available.

It is also possible to create more complex PBR materials via the sidebar material panel. For this purpose, physically-based must first be selected for the category (Fig. 20).



20

Existing materials or external content can be used to create PBR materials with the different components (Fig. 21).



21

03 Rendering

04 // Environment settings

Environment

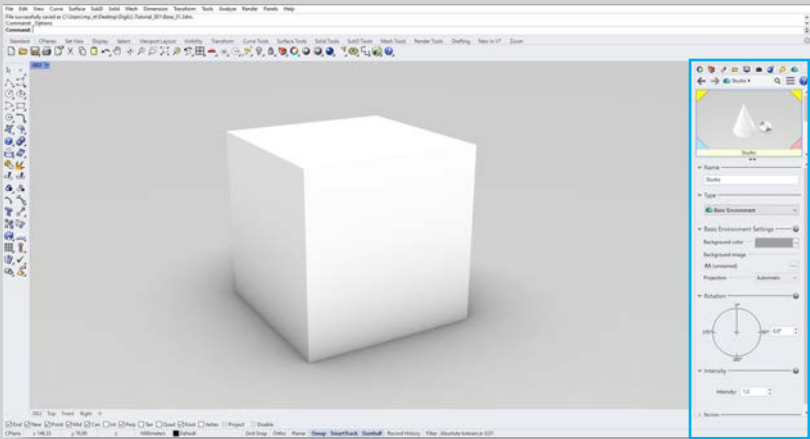
The environment defines the space around the object or scene. The colors and lights are also reflected on the object and its surroundings. Therefore, an environment can also provide the overall lighting for the scene.

The suitable environment can be selected using the environment panel or the render options in the sidebar. The settings for the environment can also be found here (Fig. 22).

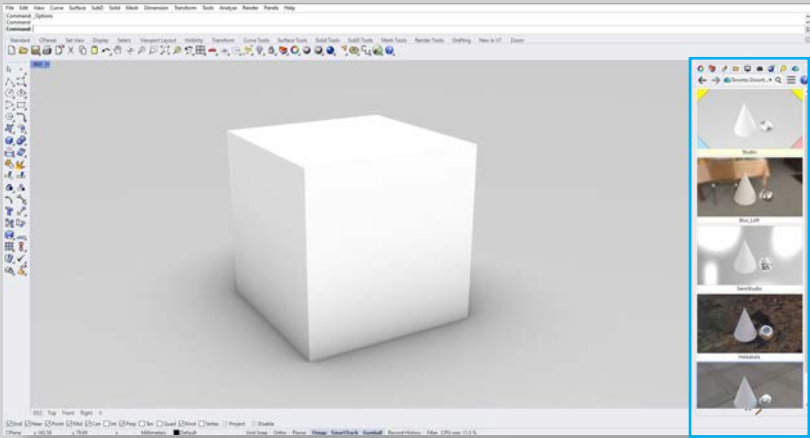
You can use a variety of Rhino provided environments or import your own, just as you can with materials (Fig. 23).

An environment can either be used to illuminate the scene or as a background as well (Fig. 24).

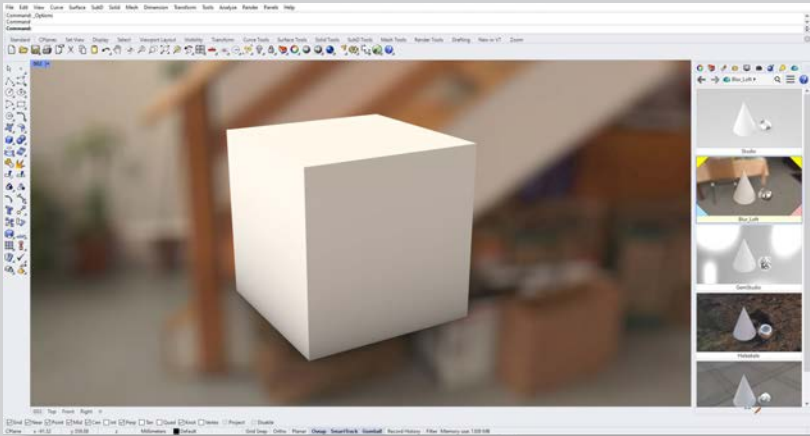
22



23



24



05 // Ground plane settings

25 Ground plane

The Ground Plane is an endless horizontal plane, which is responsible for the ground shadow. It can be adjusted in height and appearance or assigned materiality. It has the advantage that it can be rendered faster than a comparable surface as background.

The ground plane is an important part of the rendering as it is responsible for the ground shadow of an object (Fig. 25).

If the Ground plane is switched off, there is no shadow on the ground plane - if it is activated, a shadow is visible on the ground plane depending on the light source (Fig. 26).

21

Chapter 04

- 01 Overview
- 02 General settings
- 03 Resolution and quality
- 04 Backdrop settings
- 05 Lighting settings
- 06 Wireframe settings
- 07 Extended settings
- 08 Effects

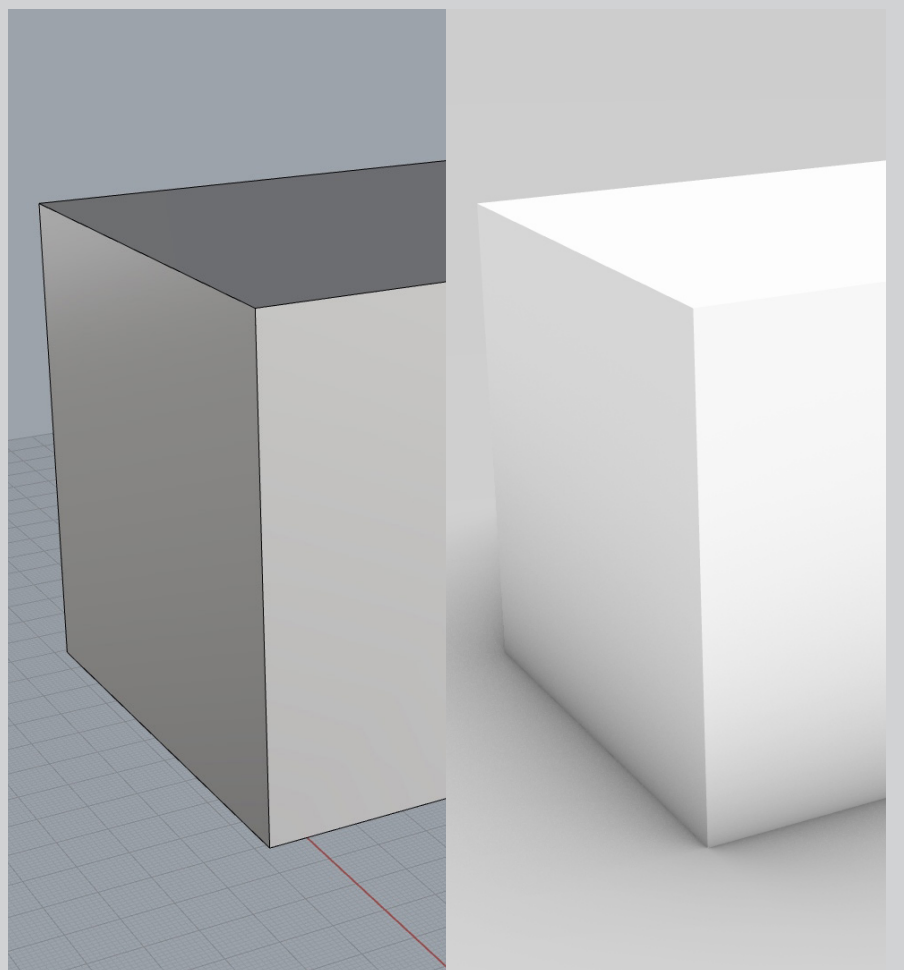
01 // Overview

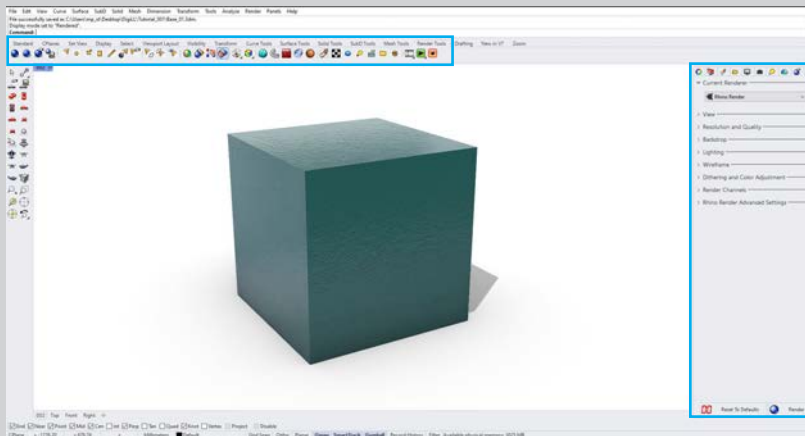
What are the important settings for rendering in Rhino?

In the following, we will take a step-by-step look at the most important settings for rendering in Rhino.

Where is the panel for the render settings?

01





Basic steps

When you open the window for the render settings, the following sub-items are visible, which again have subcategories:

- Current Renderer
- View
- Resolution and Quality
- Backdrop
- Lighting
- Wireframe
- Dithering and Color Adjustment
- Render Channels
- Rhino RenderAdvanced Settings

(Fig. 02, 03)



02 // General settings

Settings

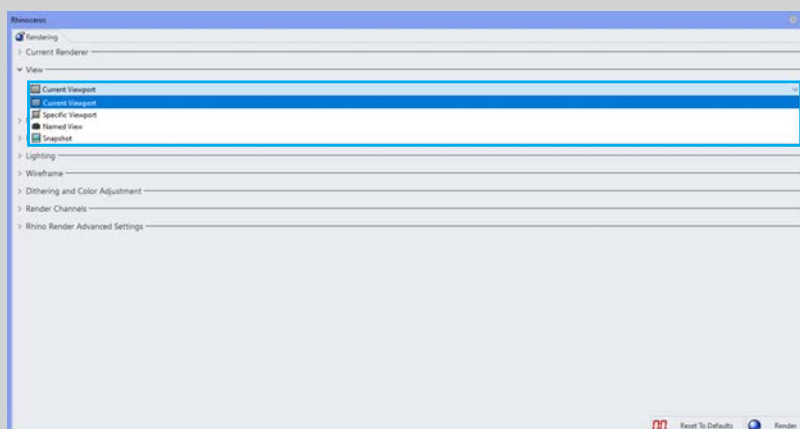
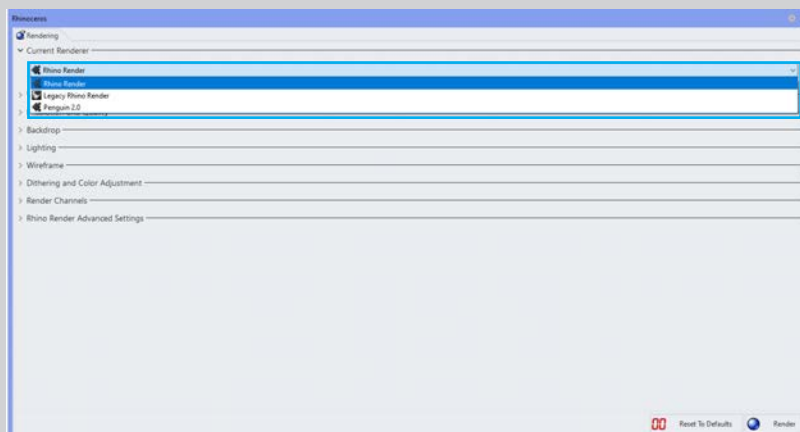
Under Current Renderer, you can set which renderer Rhino uses. Default settings are (Fig. 04):

- Rhino Renderer
- Legacy Rhino Renderer
- Penguin 2.0

There are also various options available for the menu item View. These define which view window should be used for rendering:

- Current Viewport
- Specific Viewport
- Named View
- Snapshot

(Fig. 05)



04 Render settings

03 // Resolution/quality

Resolution and quality

The Resolution and Quality selection allows you to choose different resolutions for rendering. This includes all common standard resolutions as well as the possibility to enter your own format for the resolution and also to adopt the resolution of the viewport.

Also, the DPI number can be set and the quality for the output (Fig. 05, 06):

- low quality
- draft quality
- good quality
- final quality

04 // Backdrop settings

Backdrop

The settings for the backdrop provide a wide range of possible settings. First of all, you can choose how the backdrop is visualized. For this you can choose from the following:

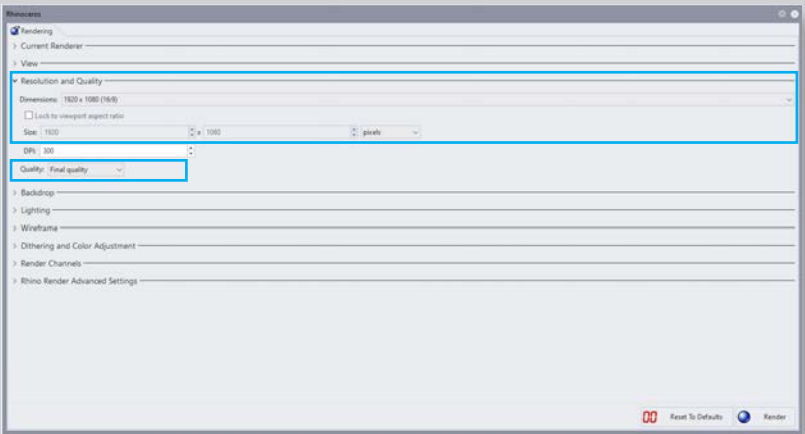
- Solid color
- Gradient
- 360 environment
- Wallpapers
- Transparent background

One option is to select a solid color for the background - this can be done using the color picker or by copying a color (Fig. 07).

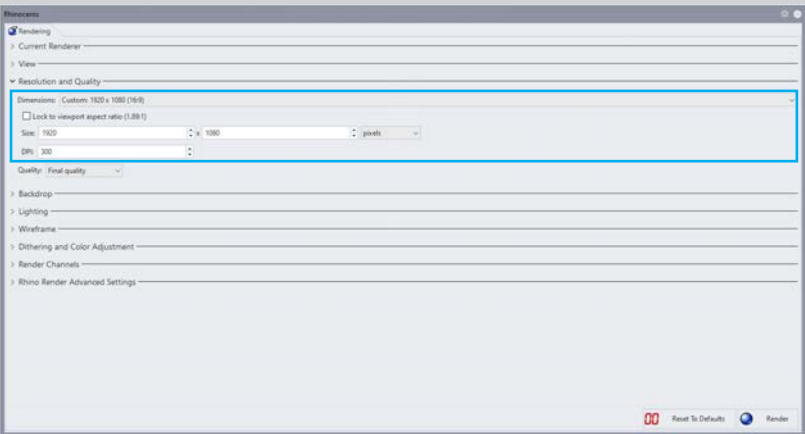
Also, you can also select whether or not a ground-plane is displayed. This is responsible for ensuring that a ground shadow is visible. It is also possible to access the Groundplane settings (Fig. 07).

Another option is to choose a gradient for the background. Here you can choose the basic colors from which the gradient is created (Fig. 08).

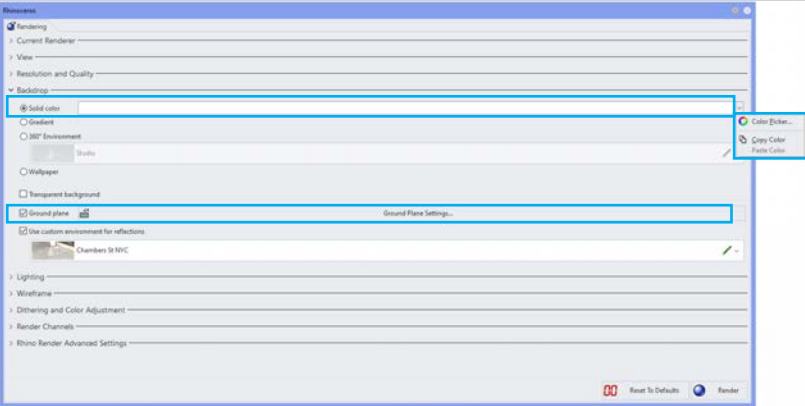
05



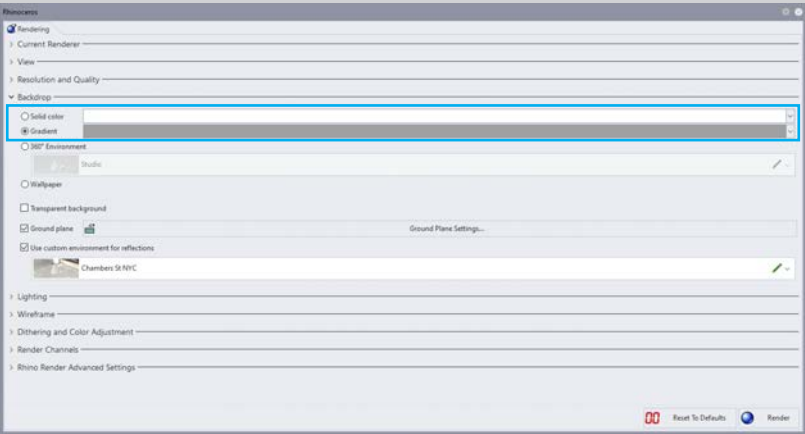
06

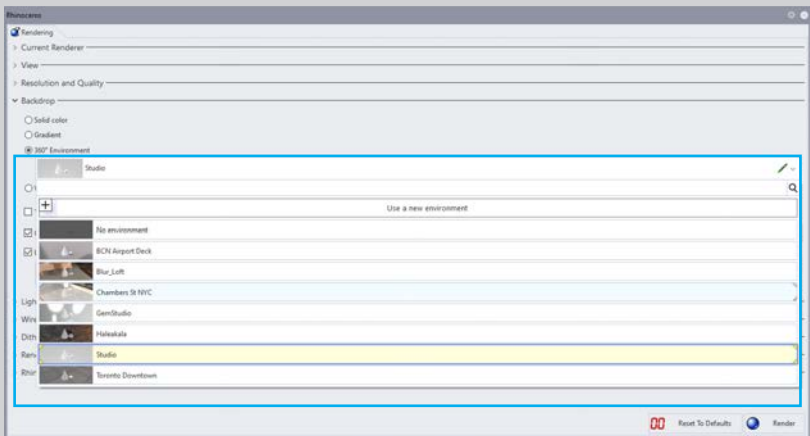


07



08

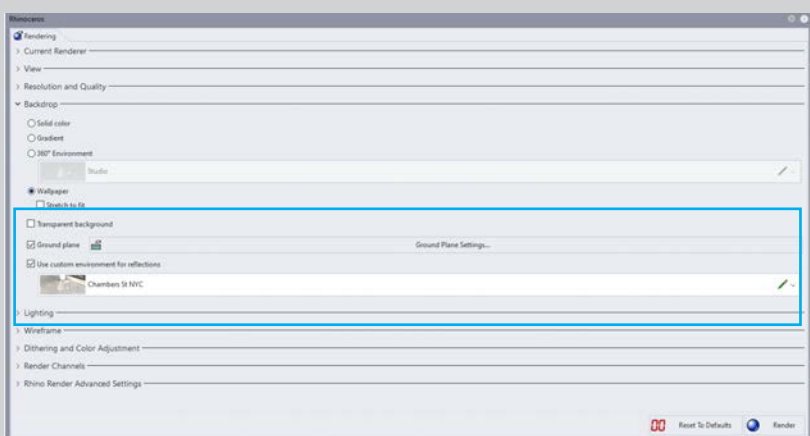




For the background, you can also select a 360-degree environment. This can be selected or imported from the attached library (Fig. 09).

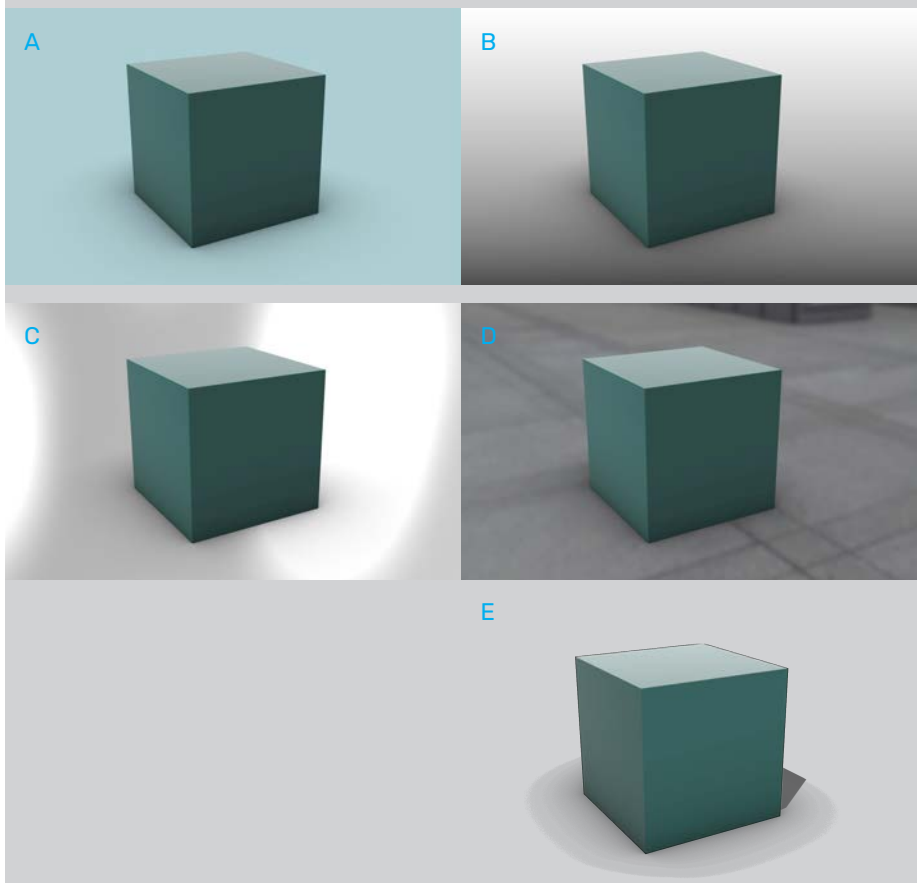
09 You can also select the option Use custom environment for reflections. This allows you to influence how the surface of the material reflects different light sources, colors, etc. of the environment (Fig. 10).

In addition, wallpaper can be inserted as a background (Fig. 10).



- A. Solid color
- B. Gradient
- C. 360° environment
- D. Wallpapers
- E. Transparent background

10 (Fig. 11).



11

04 Render settings

05 // Lighting settings

Lighting

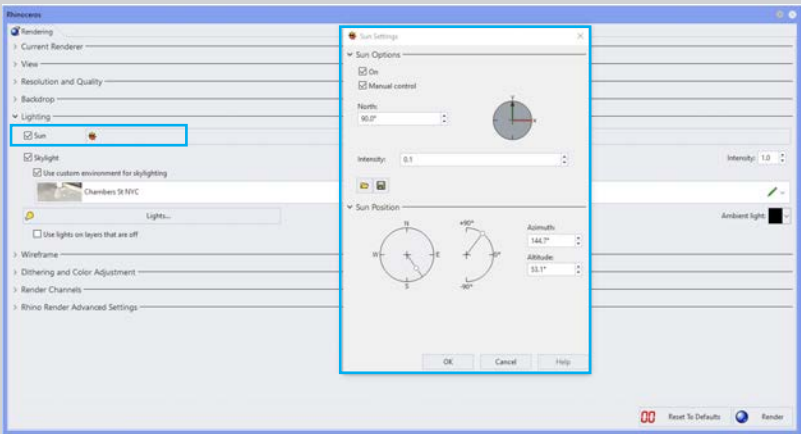
The Lighting menu item also offers a variety of settings. The most important of these are:

- Sun Settings
- Skylight
- Lights

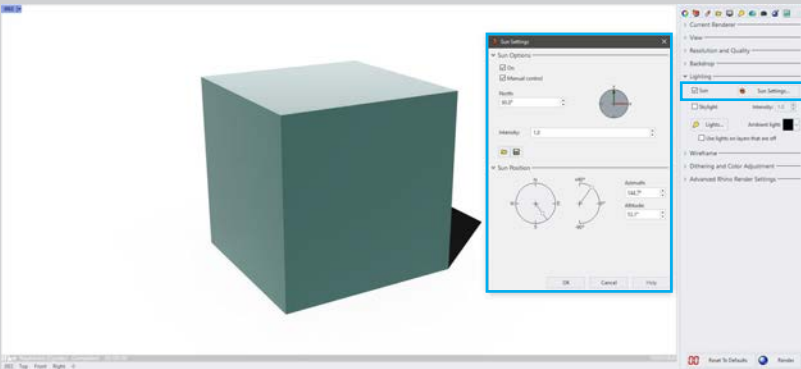
The Sun Settings allow you to simulate sunlight - the angle, the light temperature and also real times and latitudes (Fig. 12, 13).

The Skylight settings allow you to choose between different environments that illuminate the scene (Fig. 14, 15).

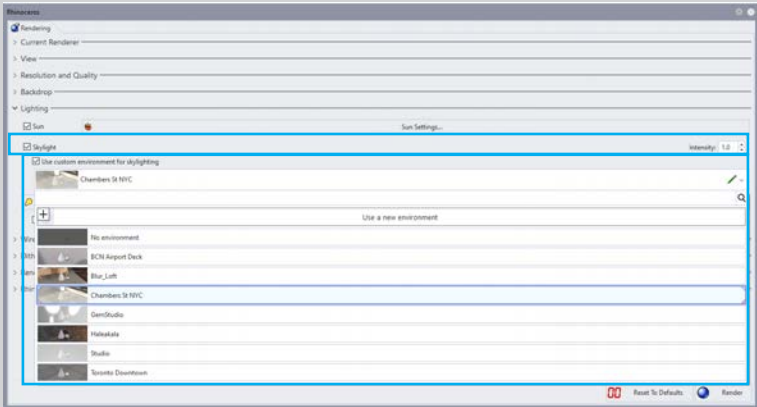
12



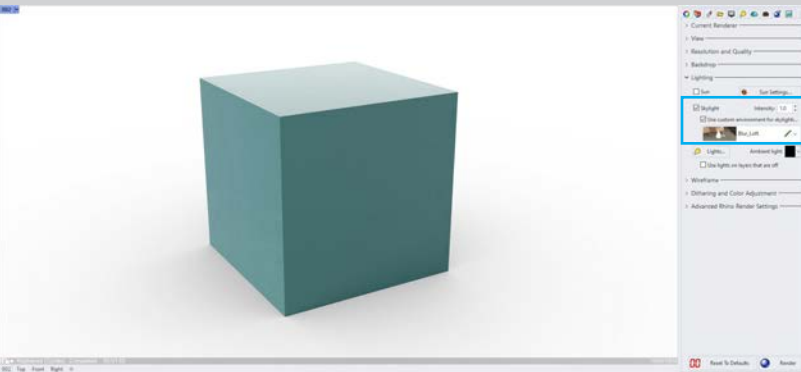
13

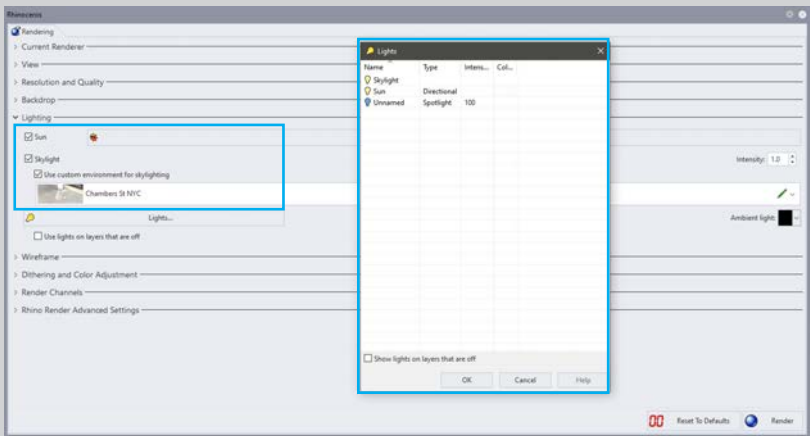


14



15



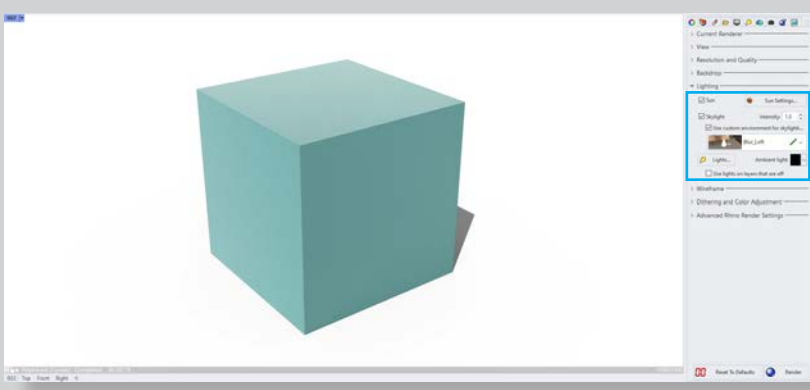


16

The light sources skylight and sun may also be used in combination. In this case, the characteristics of both lights are combined. It is important to note that the intensity of both light sources should be adjusted to avoid overexposure (Fig. 16/17).

Furthermore, the settings for the Lights offer the possibility to add various additional light sources.

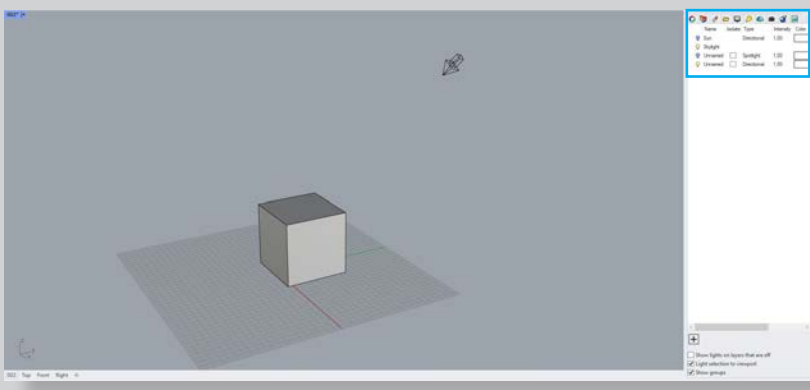
These light sources can be used for additional or accent lighting of objects or scenes. Not only the type of light but also its intensity and color can be adjusted.



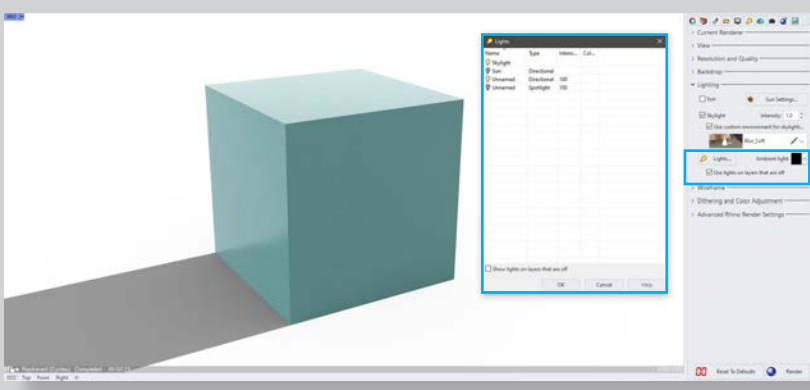
17

- Point light
- Spotlight
- Directional light
- Linear light
- Rectangular light

(Fig. 18, 19).



18



19

04 Render settings

06 // Wireframe settings

With the settings of the wireframe you can select which wireframes are also rendered, such as:

- Render curves
- Render surface edges and isocurves
- Render points and point clouds
- Render dimensions and text

(Fig. 20, 21).

07 // Extended settings

Render channel

The settings for the render channels represent the selections for the channels that will be rendered. This can either be automated or defined by the user, such as:

- RGBA
- Distance
- Standards
- Albedo

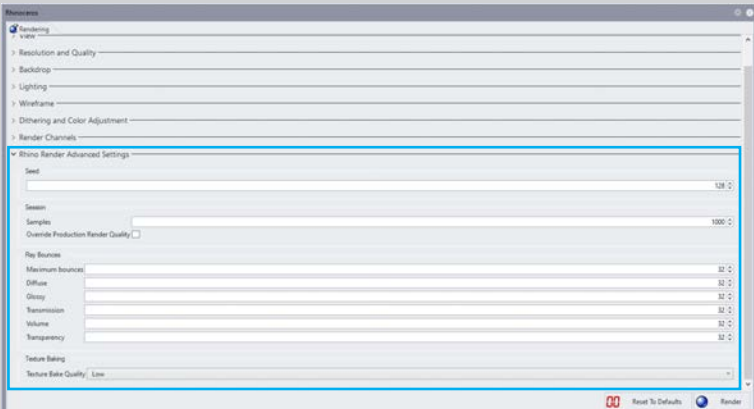
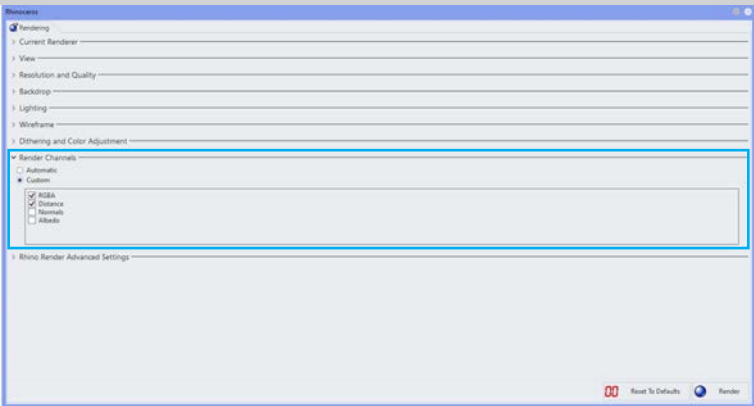
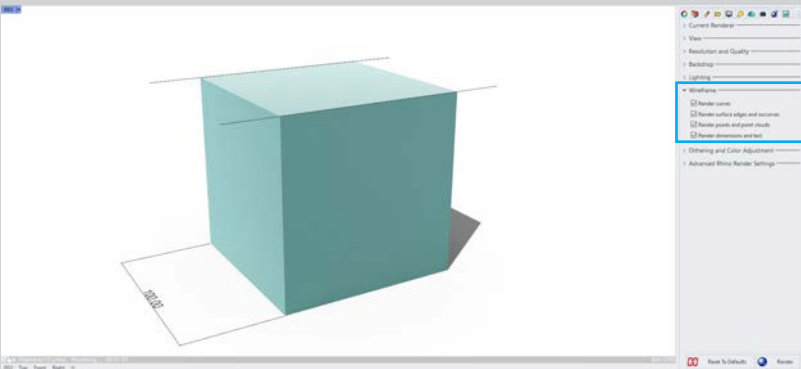
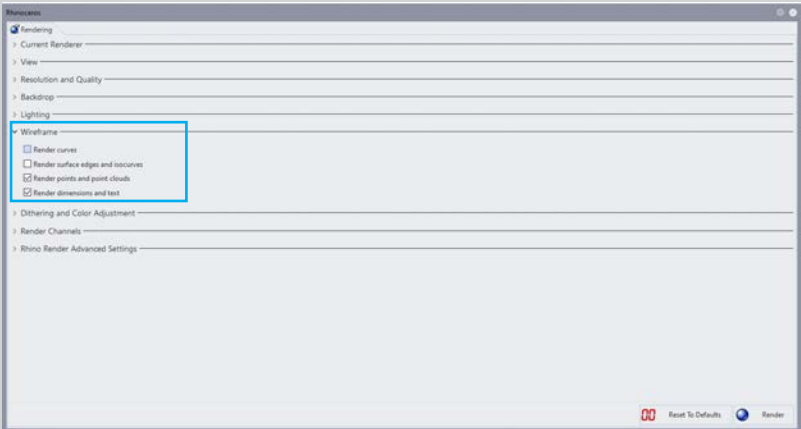
(Fig. 22).

Advanced render settings

Rhino Render Advanced Settings offer a variety of choices for output and render quality. These include:

- Seed Quantity
- Sample Quantity
- Various settings for Ray Bounces
- As well as selections for texture baking

(Fig. 23).



08 // Effects

Rhino also provides some editing options and effects for creating renderings.

24

Focal blur

The settings for the focus blur in the viewport properties control the blur that is created when more rays are projected into the scene.

(Fig. 24).

Post effects

The post-processing option offers the possibility to add various effects to the visualization. The choices for this are:

25

- bloom
- glow
- fog
- depth of field
- multiplier

(Fig. 25).

Tone mapping

With tone mapping, a high dynamic range image is converted to a low dynamic range image. There are various options for this:

26

- Clamp
- Black/white point
- Logarithmic
- Filmic
- False color

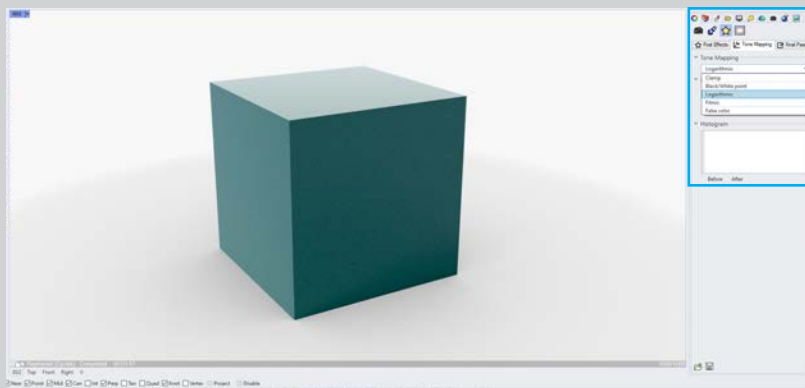
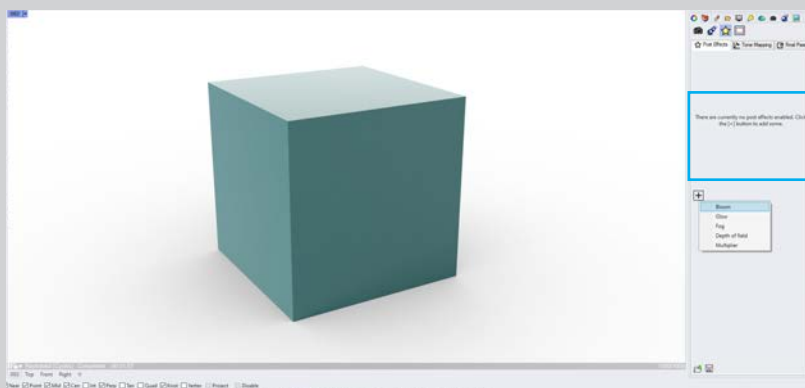
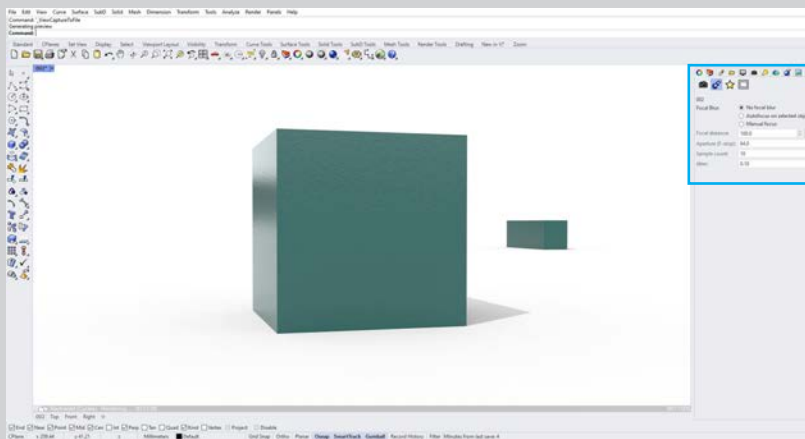
(Fig. 26).

Final pass

The final pass allows you to control the brightness and the contrast of the image.

(Fig. 27).

27



Chapter 05

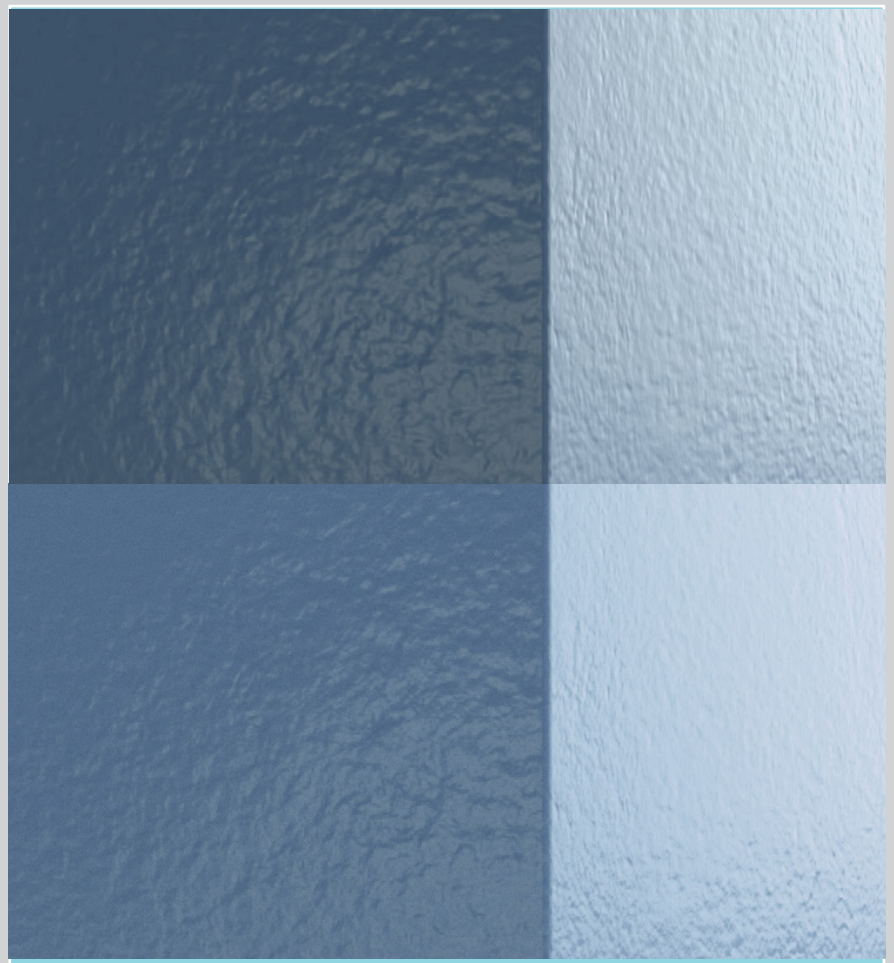
- 01 Overview
- 02 General settings

01 // Overview

Raytracing in Rhino

The Raytraced Display Mode offers the option to create renderings of high quality. In general, the results are more realistic, smoother and of better quality - depending on the hardware, it might be a bit more resource-intensive.

01



02 // General settings

02 Settings

When the raytraced display mode is selected, the background and lighting settings from the render properties are used. These settings are also found in the rendering panel (Fig. 02).

The appearance in rendered display mode varies noticeably from the actual rendering regarding the quality of the colors, surfaces, and lights.

To run the rendering, you first have to choose the parameters and then click on the render button - more about this later. The same goes for the execution using the raytraced display mode (Fig. 03).

03 Visualization in the raytraced display mode. Below the viewport of the raytraced mode, you will find various buttons and indicators, which provide information about the preview (Fig. 04).

A. Start/Pause button - Pause or resume the rendering.

B. Lock/Unlock button - Lock or unlock the view.

C. Status - Display the rendering or completed status.

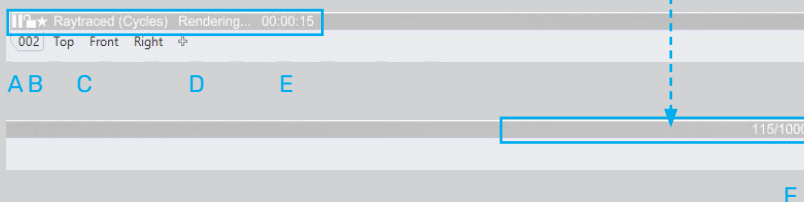
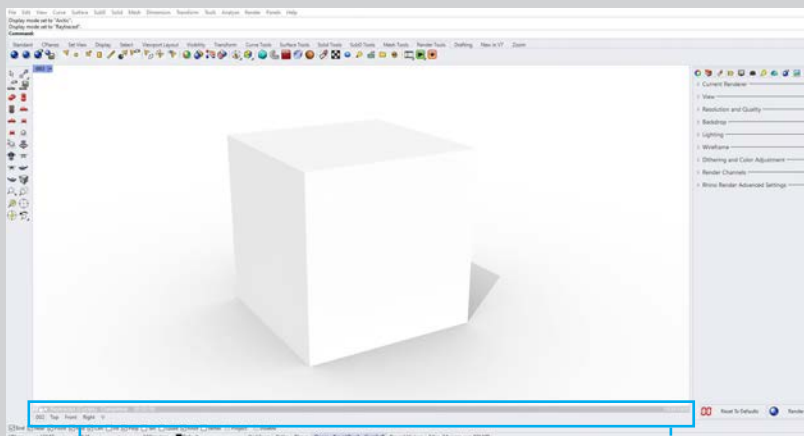
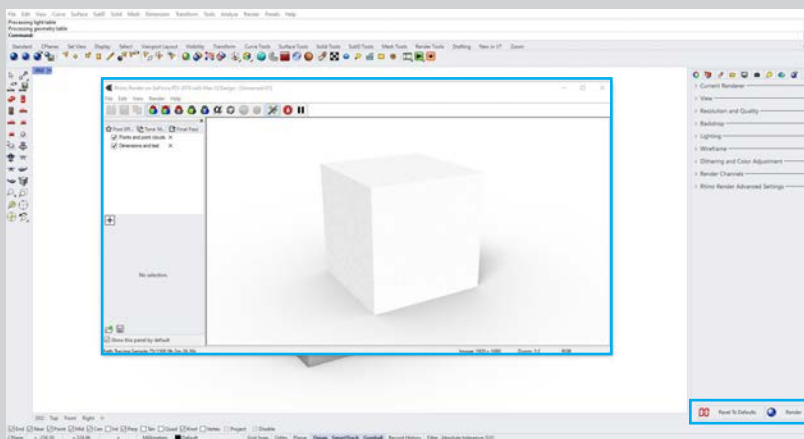
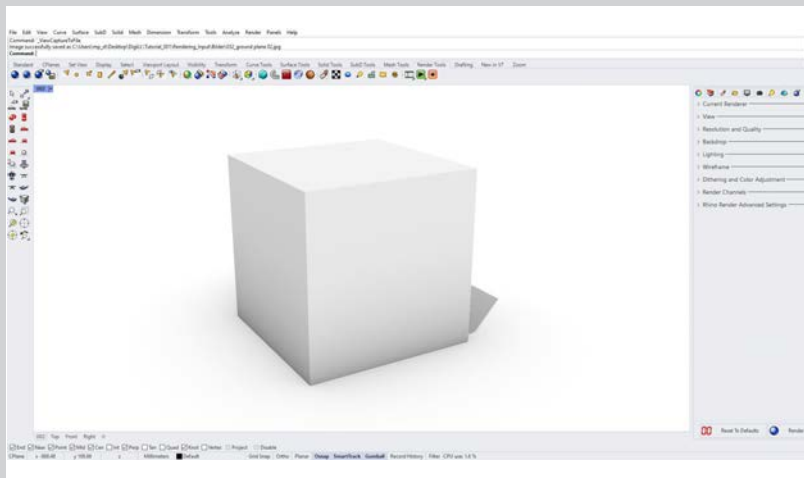
D. Device information - Click to display the current render device.

E. Time elapsed - The time used for the current rendering till now.

F. Sample count - The number of samples that have been raytraced. Click to change the sample restriction.

Raytracing will stop when it reaches the sample restriction (Fig. 05).

05



Chapter 06

- 01 Overview
- 02 Scene Organization
- 03 Camera Setup
- 04 Display Mode Setup
- 05 Coloring
- 06 Rendering

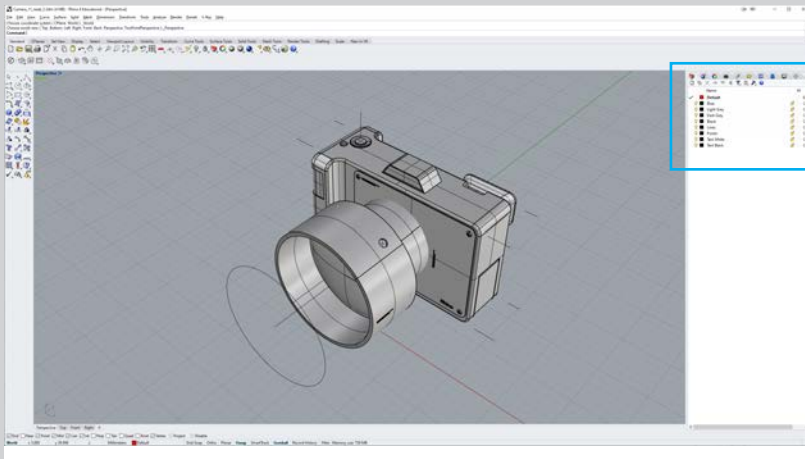
01 // Overview

Stylized Product Visualization

In this example, we will utilize what we have learned in the previous chapters to create a stylized product visualization from scratch. This work was inspired by the artist [Sushant Vohra \[1\]](#).

01





02 // Scene Organization

02

Our prepared scene already contains all the geometry we want to use for our visualization. It is organized in the following 9 layers (Fig. 02).

A. Default

This layer does not contain any geometry. Useful if we want to turn off all other layers.

B. Blue

Contains the geometry we will colorize blue.

C. Light Grey

Contains the geometry we will colorize light grey.

03

D. Dark Grey

Contains the geometry we will colorize dark grey.

E. Black

Contains the geometry we will colorize black.

A. Lines

Contains all lines.

B. Points

Contains all points.

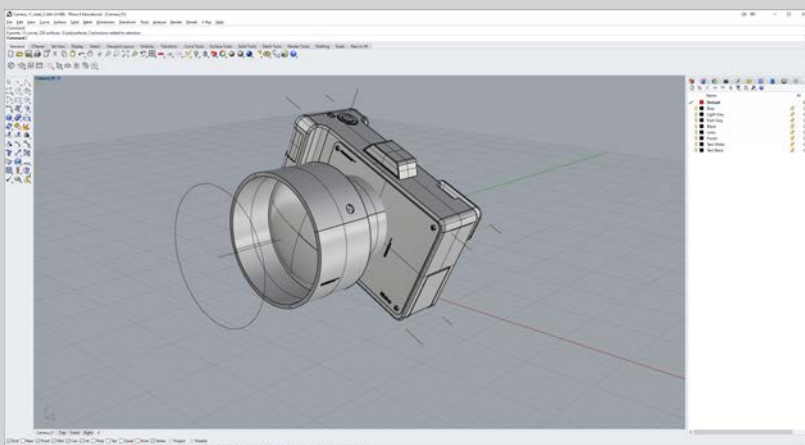
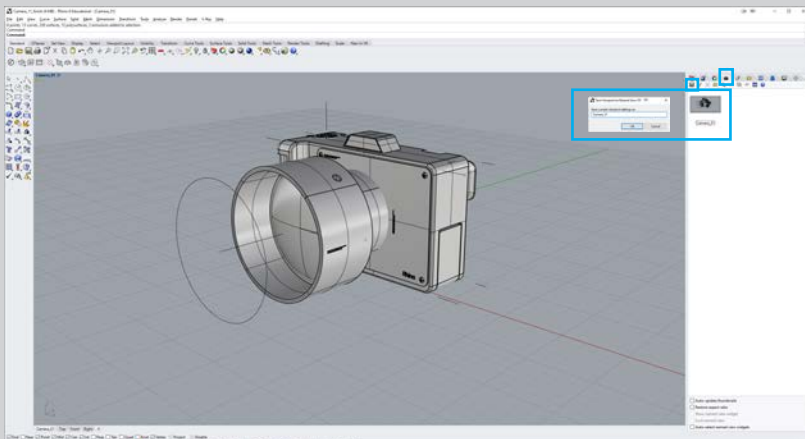
D. Text White

Contains the text we will colorize white.

04

E. Text Black

Contains the text we will colorize black.



03 // Camera Setup

For the camera setup, let's position the camera of our perspective view so that we have a 3-quarter view with a slight angle from the top. We can save the camera position, by selecting the "Named Views" tab and clicking on the "Save as" button. A window will pop up, which will let us choose a name for the current perspective (Fig. 03).

Posing

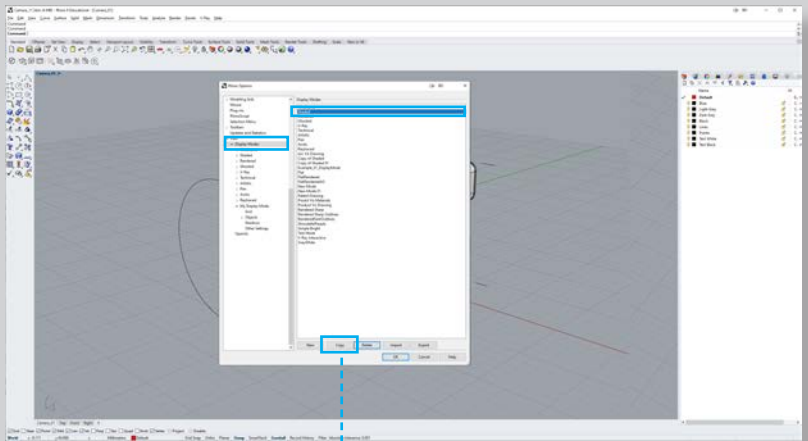
Our perspective still looks a little bit boring. Let's add more tension, by rotating our geometry by 25 degrees around the world's Y-axis (Fig. 04).

06 Product Vis

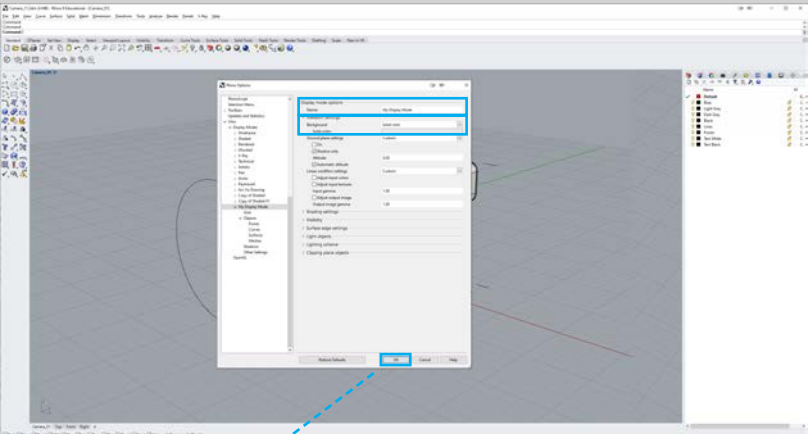
04 // Display Mode Setup

For this visualization, we will only need one Display Mode. We will start off by opening the Rhino Options menu and copying the existing "Shaded" Display Mode (Fig. 05). We will rename it to "My Display Mode". Next, let us change the background color to a light grey and close the settings window by clicking the OK button (Fig. 06). Let us apply our custom display mode, by selecting it from the Drop-Down menu in the viewport. We will immediately see the change in the visual appearance of our scene (Fig. 07).

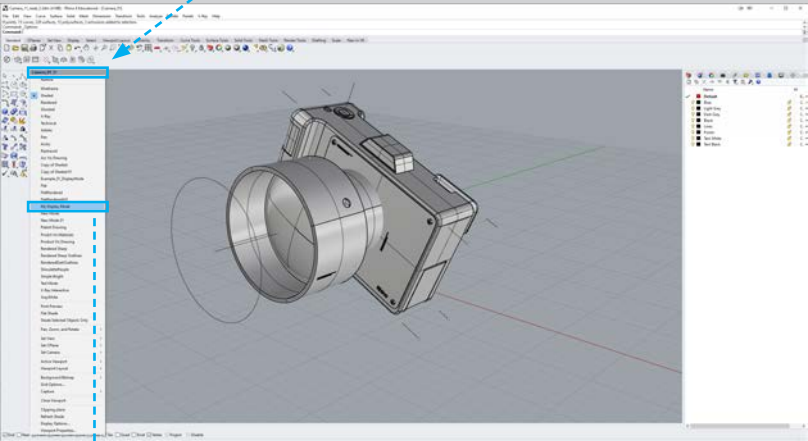
05



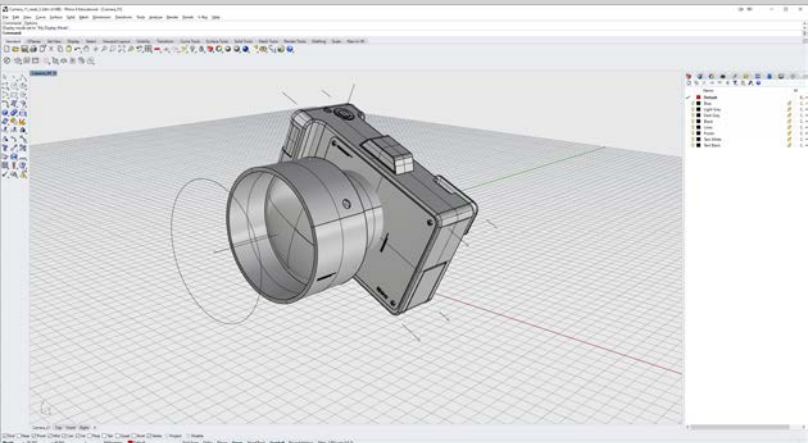
06

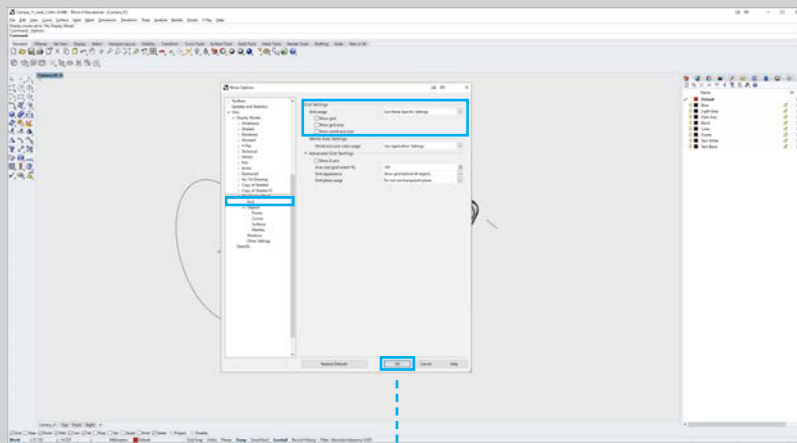


07



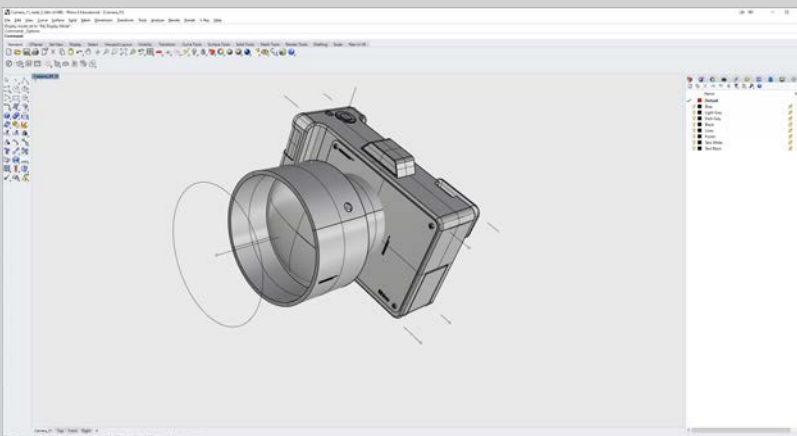
08





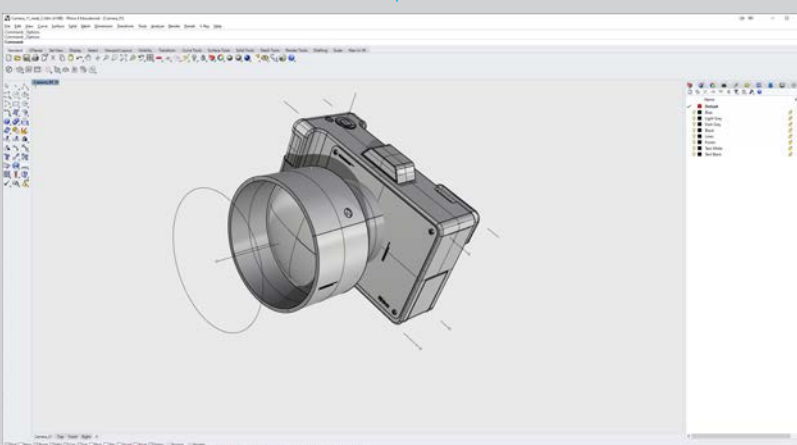
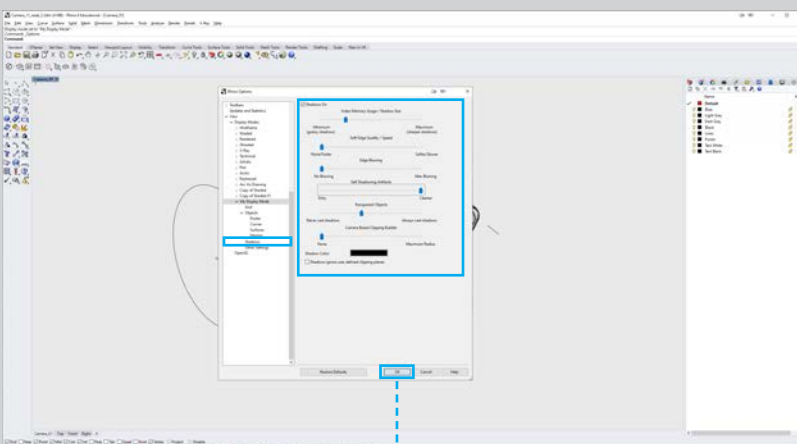
09 Grid Adjustment

Let's continue by adjusting the grid. For this visualization, we don't want it to be visible at all. As discussed earlier, we can turn off the grid, by going into the Grid settings of our display mode. Let's set "Grid usage" to "Use Mode Specific Settings" and turn off the "Show grid", "Show grid axes" and "Show world axis icon" options. If we press the "OK" button, we can see that the grid has completely disappeared (Fig. 09, 10).



Shadows

Next, let us add some shadows, so we can get a better sense of the shape of our camera geometry. We can do so by turning on the "Shadows On" option in the "Shadows" Tab of our display mode. Let's turn down the "Soft Edge Quality/Speed" and "Edge Blurring" sliders and crank up the value for "Self Shadowing Artifacts". This will leave us with a very crisp and sharp shadow appearance (Fig. 11, 12).



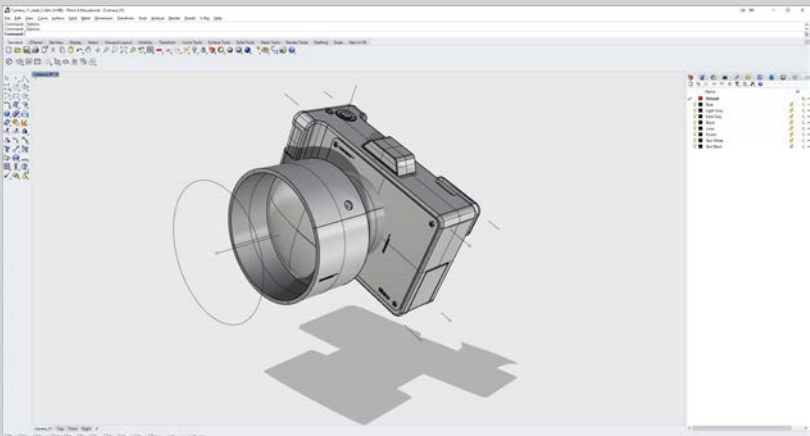
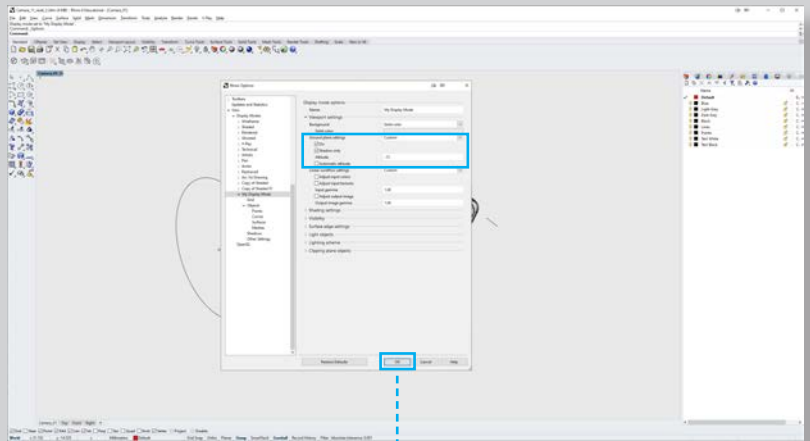
06 Product Vis

Ground Plane

Right now, our camera geometry just seems to be floating in empty space. However, we can give our visualization a more authentic impression, by adding a drop shadow to our scene. Therefore, we will need a ground plane. Let us go into the Viewport settings of our display mode and set the "Ground plane settings" option to custom. Next, we will check the "On" option. Since we only want to get a drop shadow for our camera, but still don't want to see any plane below it, let us also check the "Shadow only" option. Last, but not least, we need to define the location of our ground plane. Since we still want our camera to be floating above the ground, we will turn off the "Automatic altitude" checker and set a custom value for the altitude. We will go with a value of -15 here. If we now confirm our changes by pressing the "OK" button, we will see that our camera is now casting a nice sharp shadow on the ground below it. However, we can achieve a more dramatic look, by adjusting the lighting. We will take care of this in the next step (Fig. 13, 14).

13

14

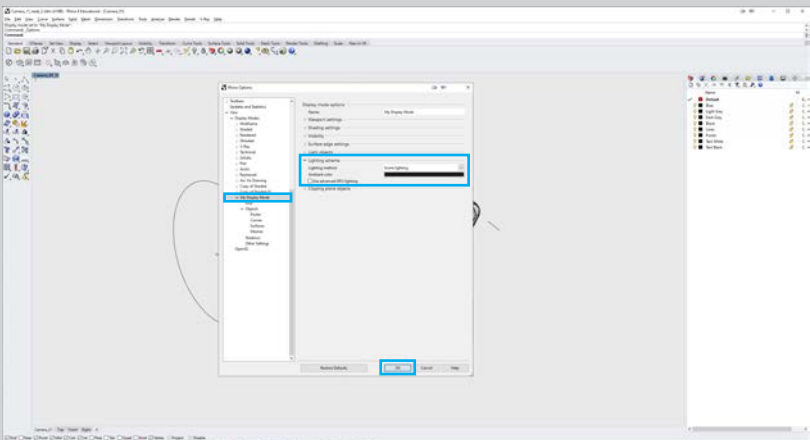
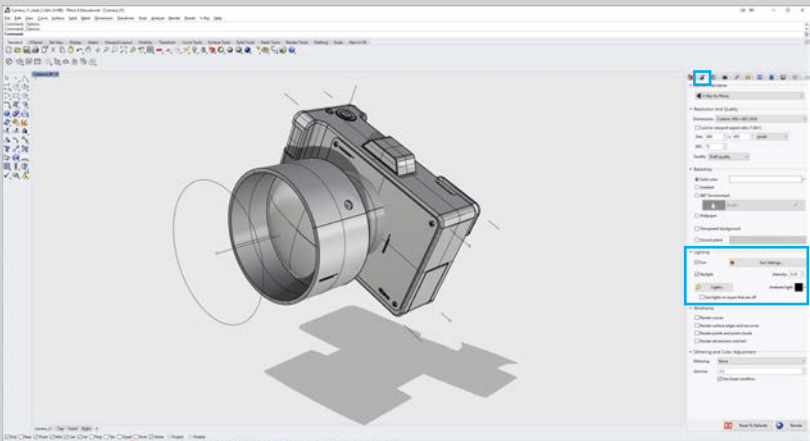


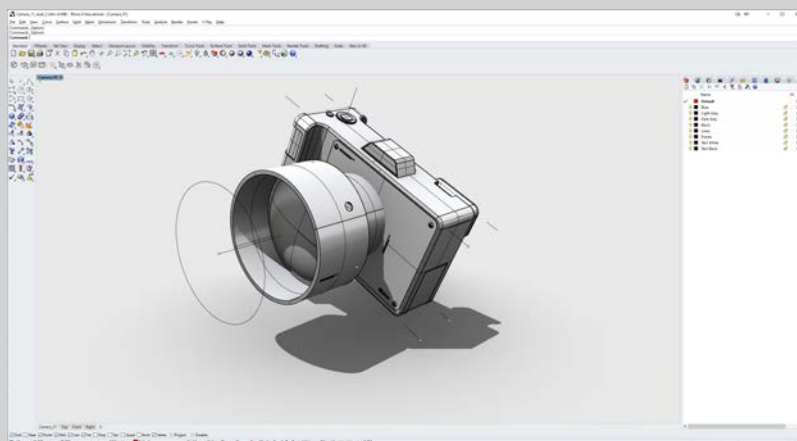
Light Setup

To change the lighting of our scene, let's go into the rendering menu. In the "Lighting" tab, we will turn on Sun and Skylight. We also want to reduce the intensity of the skylight to 0.35 (Fig. 15). As you have noticed - nothing has changed so far. That's because we still need to tell our display mode to use the scene lighting. We do this in the Rhino Options under the Lighting scheme tab of our display mode options. Let's click on the Lighting method and set it to "scene lighting" and confirm our changes by pressing okay (Fig. 16). We'll see the difference right away.

15

16

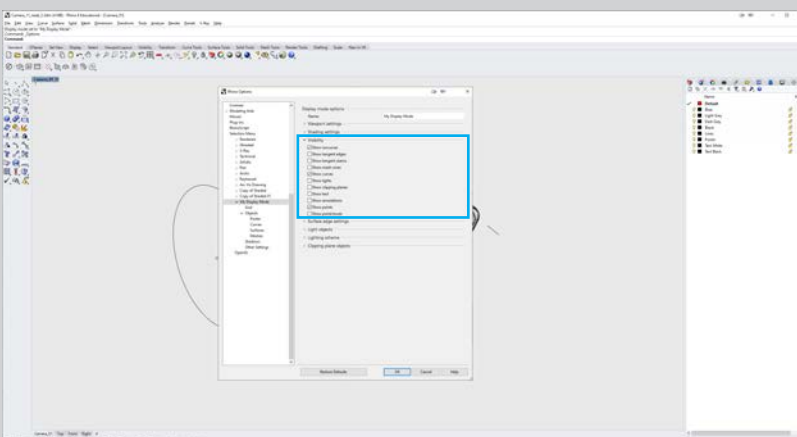




Lines and Contours

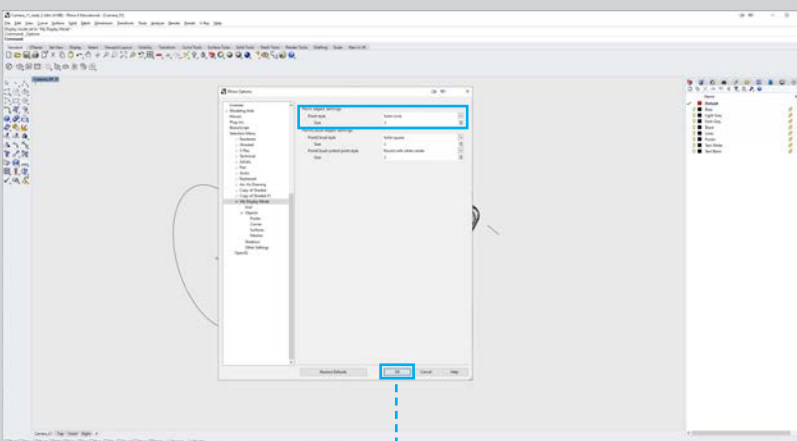
17 Before we continue coloring our camera, let us add some more interest to our visualization by adding some contour and construction lines. The scene already contains some geometry for that purpose. However - you are free to add more on your own.

For our visualization, we only want to show isocurves, curves, and points. Therefore, we need to select them in the Visibility tab of our Display mode options and turn off all other geometry types. This should do the trick for us (Fig. 18).

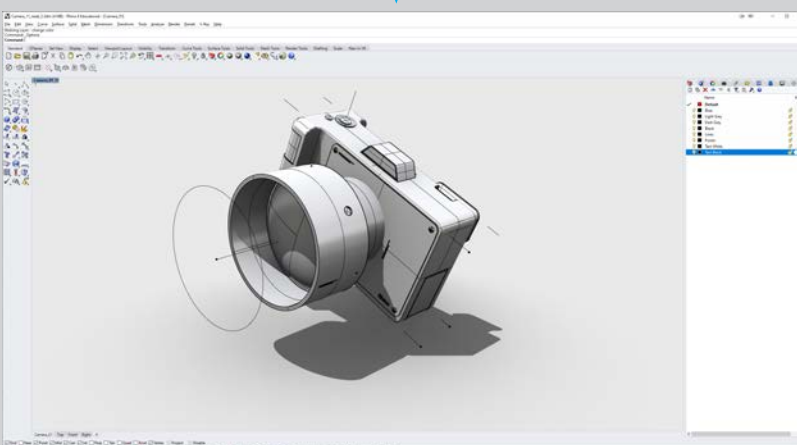


18 Last, but not least, we want to change the display style of our point objects. Right now, they are displayed as circles with a white center. We want to change their appearance to solid black circles, so they fit more into the rest of the visualization. Let us open the Point object settings and change the "point style" to "solid circle". We could also increase the size of our point objects if we would like to. Let's close the window by pressing okay (Fig. 19, 20).

Now that we got everything else out of the way, let's continue with the coloring process.



19



20

06 Product Vis

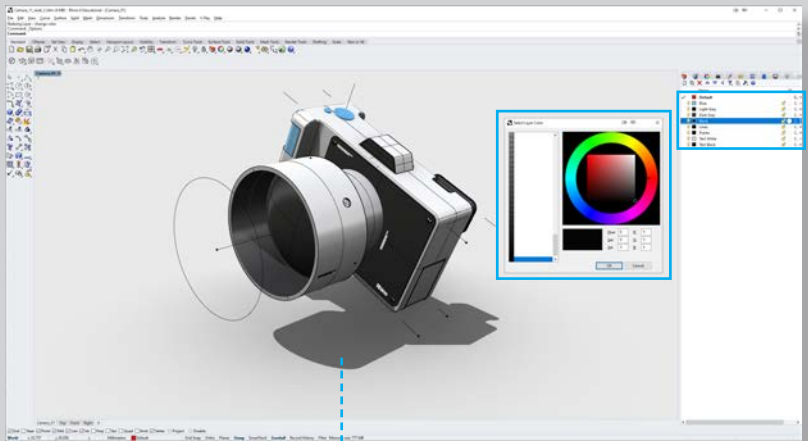
05 // Coloring

As discussed in the beginning, we have already structured the scene beforehand, so that all objects of the same color share one layer. This makes the coloring process very intuitive and easy. By doing a double click on the color swatch icon next to each layer, we can simply choose a color for all its objects. Of course, we could further customize the appearance of our scene by creating more layers for different colors. However, for the camera visualization, we will go with a quite minimalistic grey - bluish look (Fig. 21, 22).

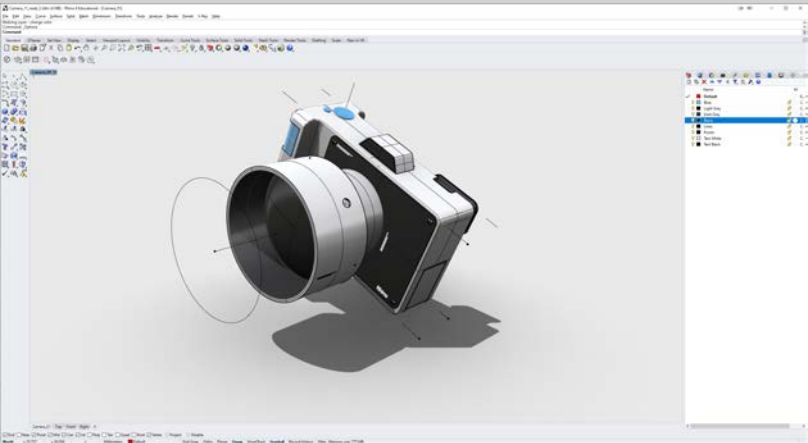
06 // Rendering

As soon as we are done with the coloring process, we can finally save out our image. We can easily do that by using the "ViewCaptureToFile" command in the command terminal. It will first let us choose our View. We can select the named view "Camera_01" we have created earlier. Next, under the Options menu, we can turn on the "Transparent Background" option. This will make it easy, if we want to further edit our visualization, by composing it into another image. Last, we want to take care of the resolution. I will go with a typical Full HD resolution of 1920 x 1080. When we press okay, Rhino will let us choose where to save our file (Fig. 23).

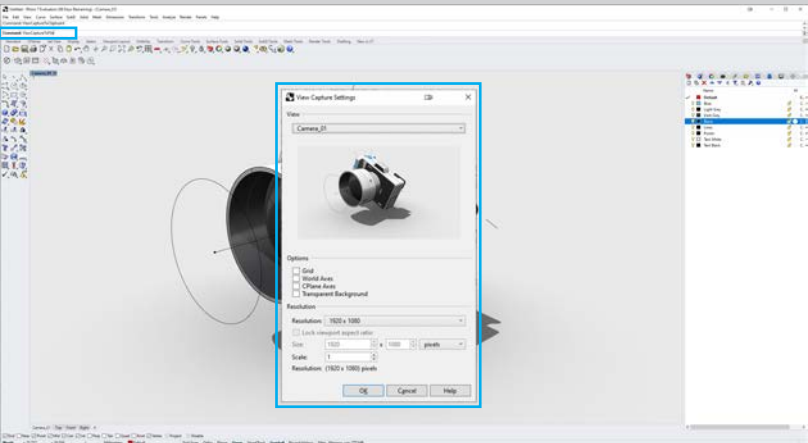
21

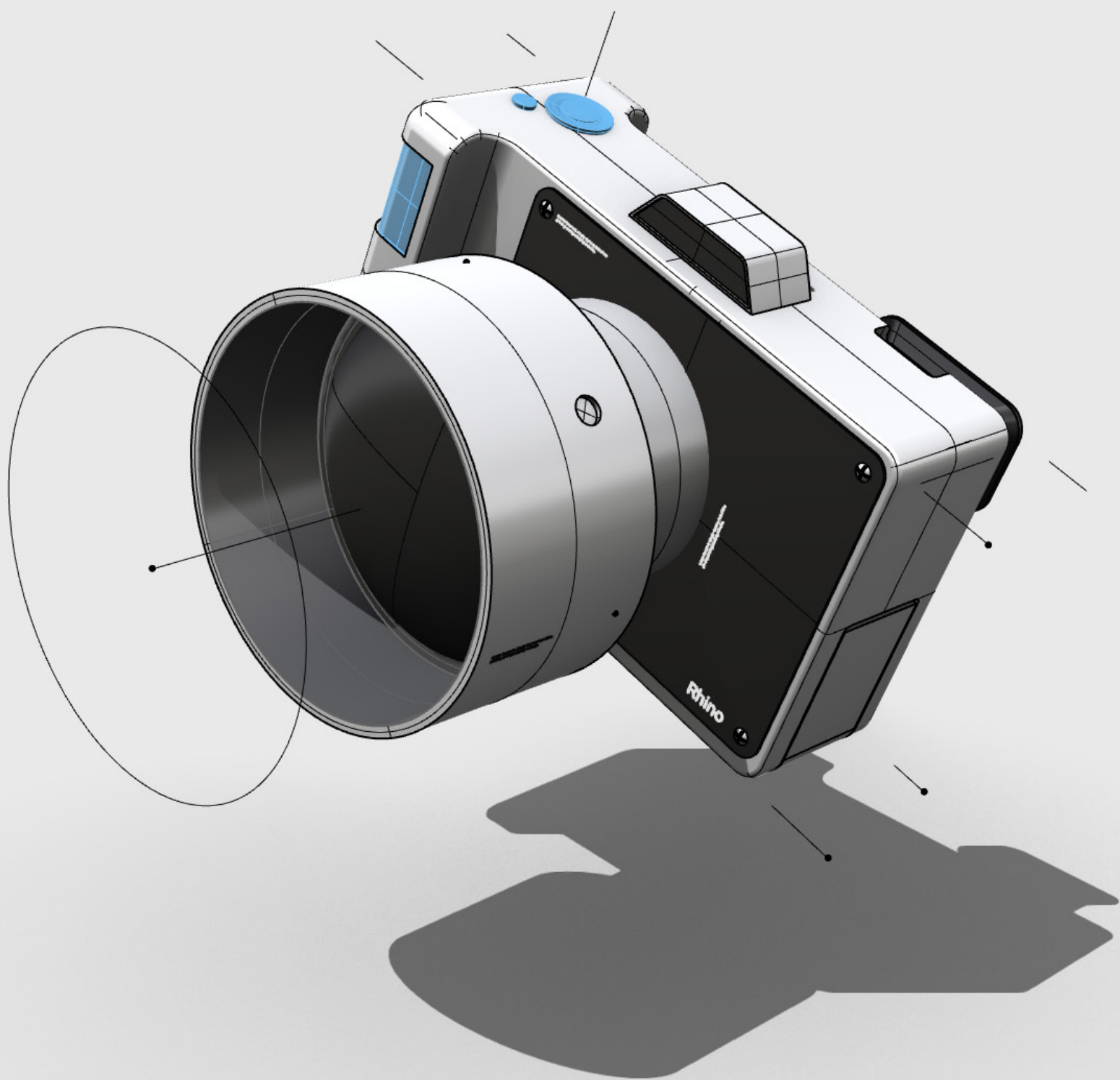


22



23





Chapter 07

- 01 Overview
- 02 Scene Organization
- 03 Camera Setup
- 04 Display Mode Setup
- 05 Material Creation
- 06 Rendering

01 // Overview

Stylized Architecture Visualization

In this example, we will utilize what we have learned in the previous chapters to create a stylized architecture visualization from scratch. The project files required can be found [here](#).

This work was inspired by the artists [Fer Neyra \[1\]](#) and [Tishk Barzanji \[2\]](#).

01



02 // Scene Organization

02 The prepared scene file already contains all geometry we want to use for our visualization. It is organized in the following eight layers (Fig. 02, 03).

A. Default

This layer does not contain any geometry.

However, it is always nice to keep a presentation layer in case we want to turn off all other layers.

B. Ground

Contains the ground geometry.

C. Architecture

Contains the architecture geometry.

D. Lines

Contains all lines.

E. People

Contains a mesh of a walking person.

F. Silhouettes

Contains all planes we will use to create the silhouettes of the scene - like bushes, trees, and birds.

G. Sun

Contains the plane we will use to illustrate the sun.

H. Lights

An empty layer on which we will place our light

04

03 // Camera Setup

The scene file already contains a named view, that fits the composition. Of course, you are free to experiment with the perspective on your own (Fig. 04). Detailed instructions on how to set up a camera can be found in the first chapter of this book.

04 // Display Mode Setup

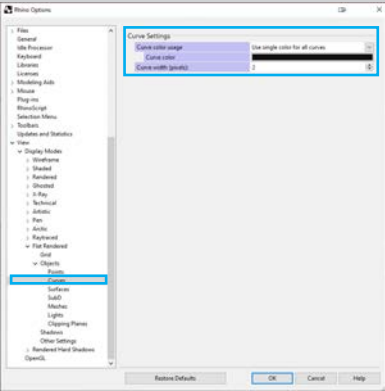
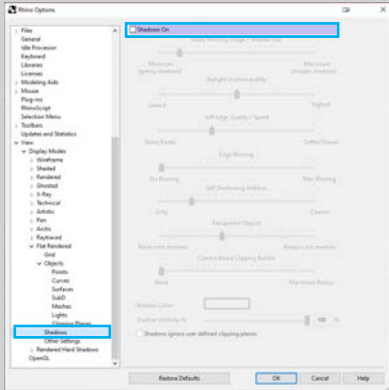
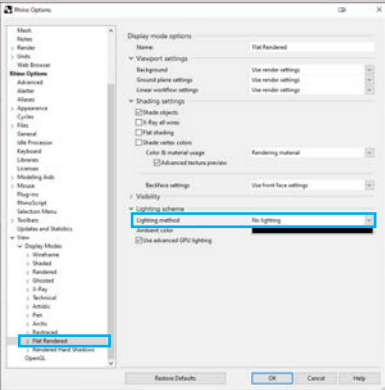
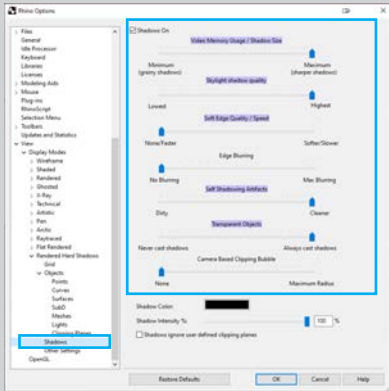
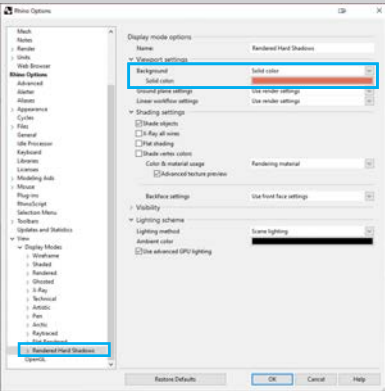
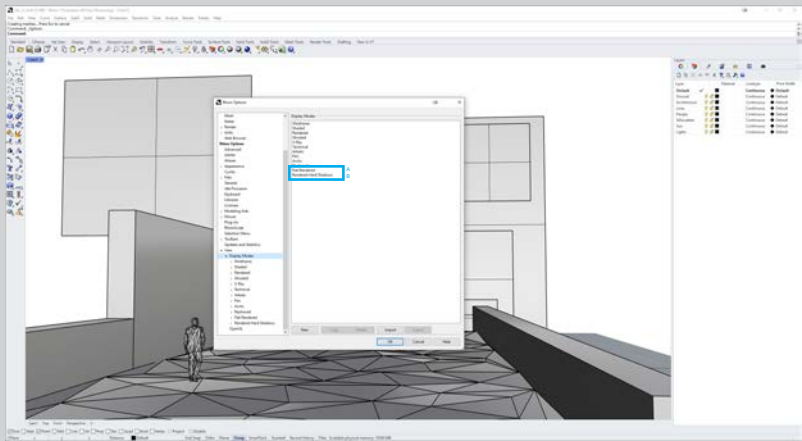
For this visualization, we will need two different Display Modes which we will mix together. We will assign the first Display Mode to the whole scene, while we will use the second one to only change the appearance of individual objects.

Display Mode 1

We will start off by opening the Rhino Options menu and copying the existing "Rendered" Display Mode and configure it accordingly. We will rename it to "Rendered Hard Shadows". Next, let us change the Background color to a warm orange and go to the Shadows option. We want to get really crisp shadows, so let's adjust our shadow settings accordingly (Fig. 05, 06).

Display Mode 2

For the second Display Mode, we will again copy the existing "Rendered" Display Mode and rename it to "Flat Rendered". We will use that one for the sun and silhouette objects. Since those should give a fairly abstract impression, we want to get rid of any lighting and shadows. Furthermore, we will use this Display Mode also for our curve objects in the Lines layer. Therefore, we will adjust their appearance, so that it fits the rest of the illustration. We will give it dark color and a little bit more thickness (Fig. 05, 07).



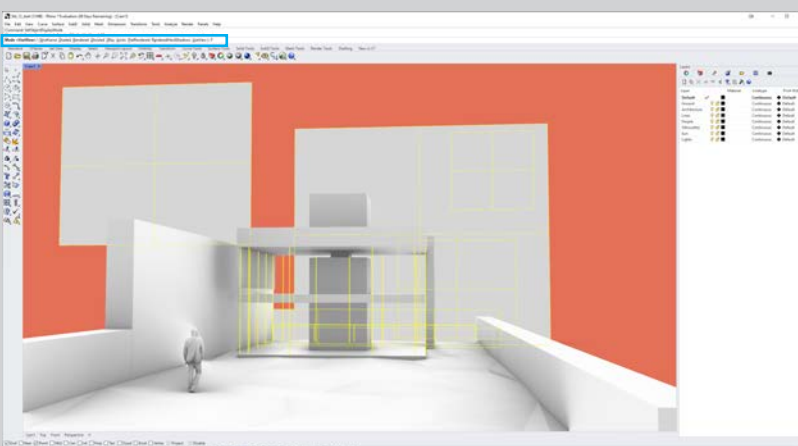
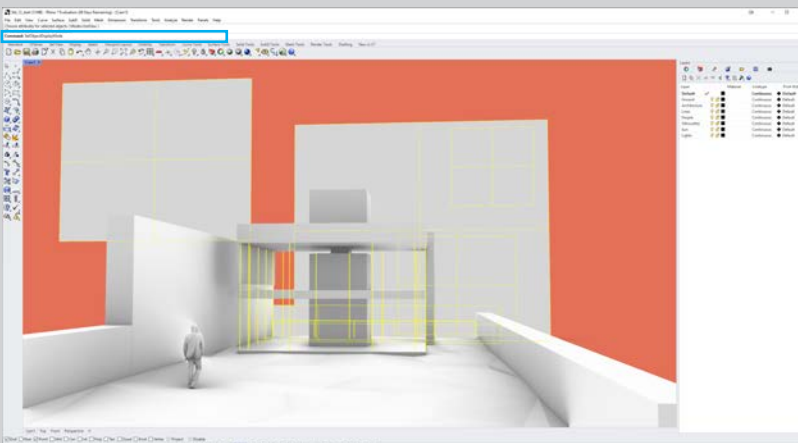
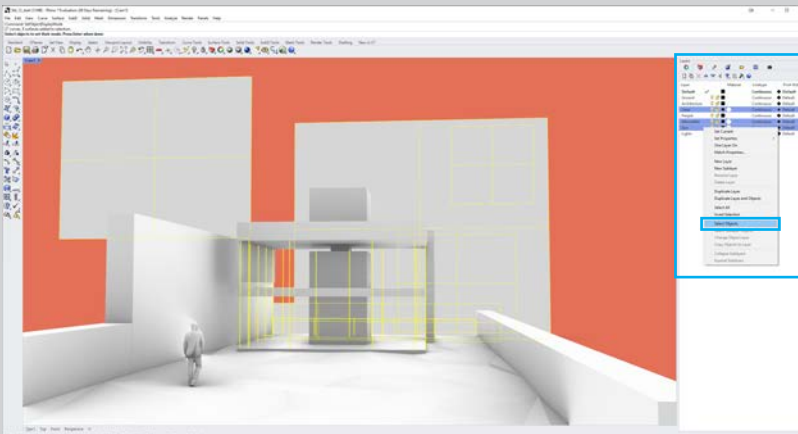


Applying Display Modes

We will use the first Display Mode "Rendered Hard Shadows" as the base style for our scene.

Let's choose it from the drop-down menu of the viewport to apply it to our composition (Fig. 08).

Next, we will select all objects from the Lines, Silhouettes, and Sun layer and use the "SetObject-DisplayMode" command. We can type "M" to see all available Display Modes. Let us choose the "Flat Rendered" Display Mode by typing "F" and apply it to the selected objects (Fig. 09, 10, 11).



07 Arc Vis

Light Setup

Let's continue by adjusting the lighting. For this visualization, we only need to create one light source. Let's choose the directional light while we have our "Light" layer selected. We, so that it will approximately fit our abstract suns direction (Fig. 12).

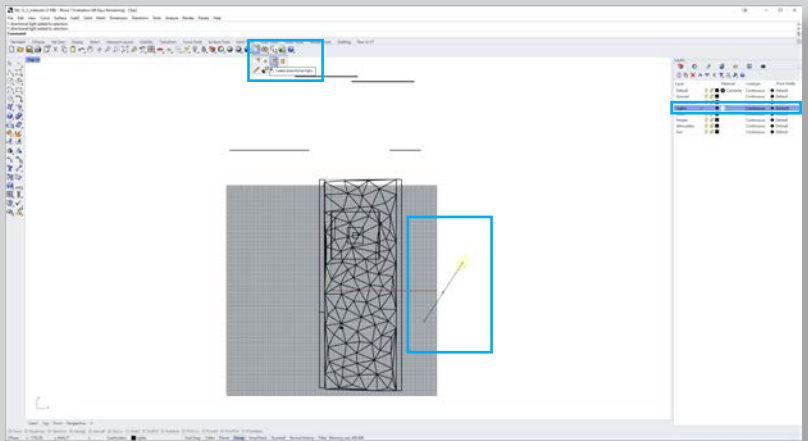
Next, we need to finetune our light settings. We can find it under the properties tab when our light is selected. Let's change its color to our orange background color and set its intensity to 10. The shadow intensity can be left as it is - at 100 (Fig. 13).

Right now, we won't see any difference in color in the viewport, since we first need to apply materials to our objects. We will do this after the lighting setup.

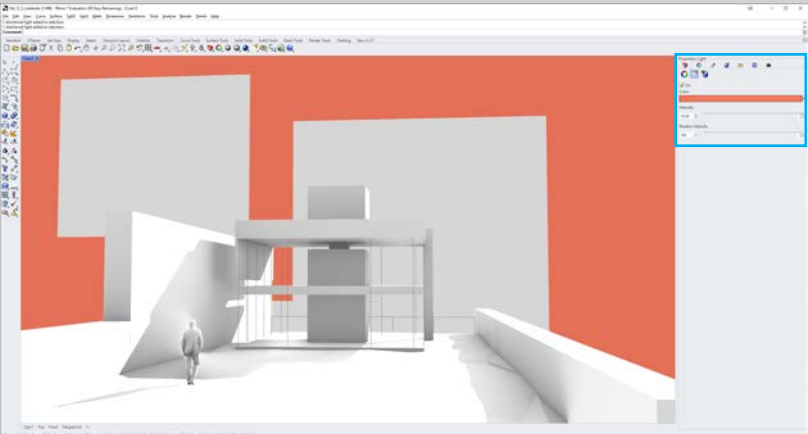
Lighting Settings

Now, that we have set up our directional light, we still need to tweak the lighting settings. We will find those in the "Rendering" tab. For this visualization, we just want to uncheck the "Use custom environment for skylighting". This will give us a regular illuminated abience lighting, which is more suited for the stylized look we are going (Fig. 14).

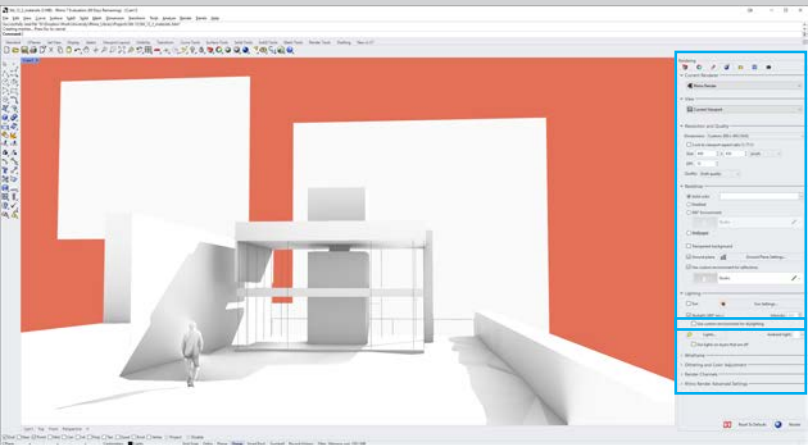
12

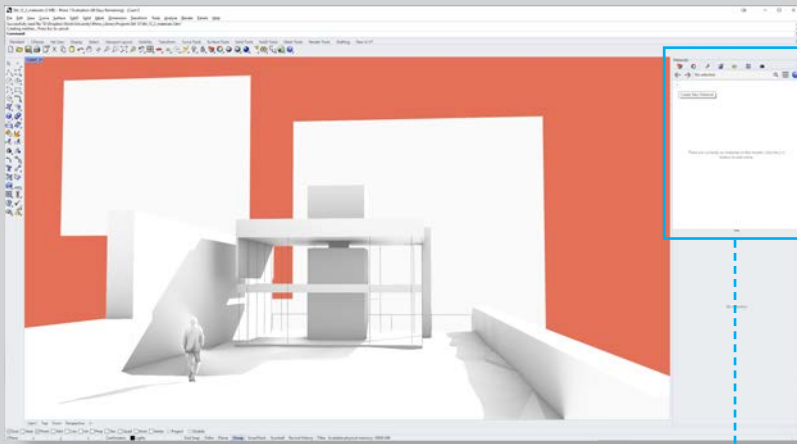


13



14





05 // Material Creation

15

Material Setup

For the material setup, we'll create a total of seven custom materials (Fig. 15, 16).

A. People

The material for our walking person in the foreground of the image.

B. Trees

The material for the silhouette trees.

16

C. Concrete

The material for the architectural elements in the scene.

D. Bushes

The material for the silhouette bushes.

E. Ground

The ground material.

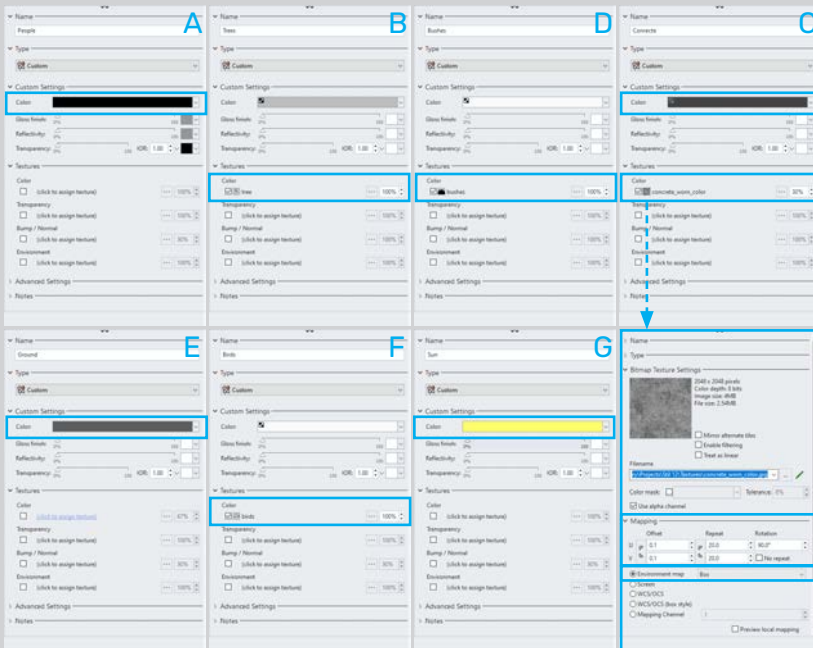
F. Birds

The material for the silhouette birds.

G. Sun

The sun object material.

17



06 // Rendering

Now that we have created and applied all of the materials, we can finally save out our image. We can easily do that by using the "ViewCaptureToFile" command in the Command terminal.





Chapter 08

- 00 Overview
- 01 Style A
- 02 Style B
- 03 Style C
- 04 Style D
- 05 Style E
- 06 Style F
- 07 Style G
- 08 Style H
- 09 Style I
- 10 Style J
- 11 Style K

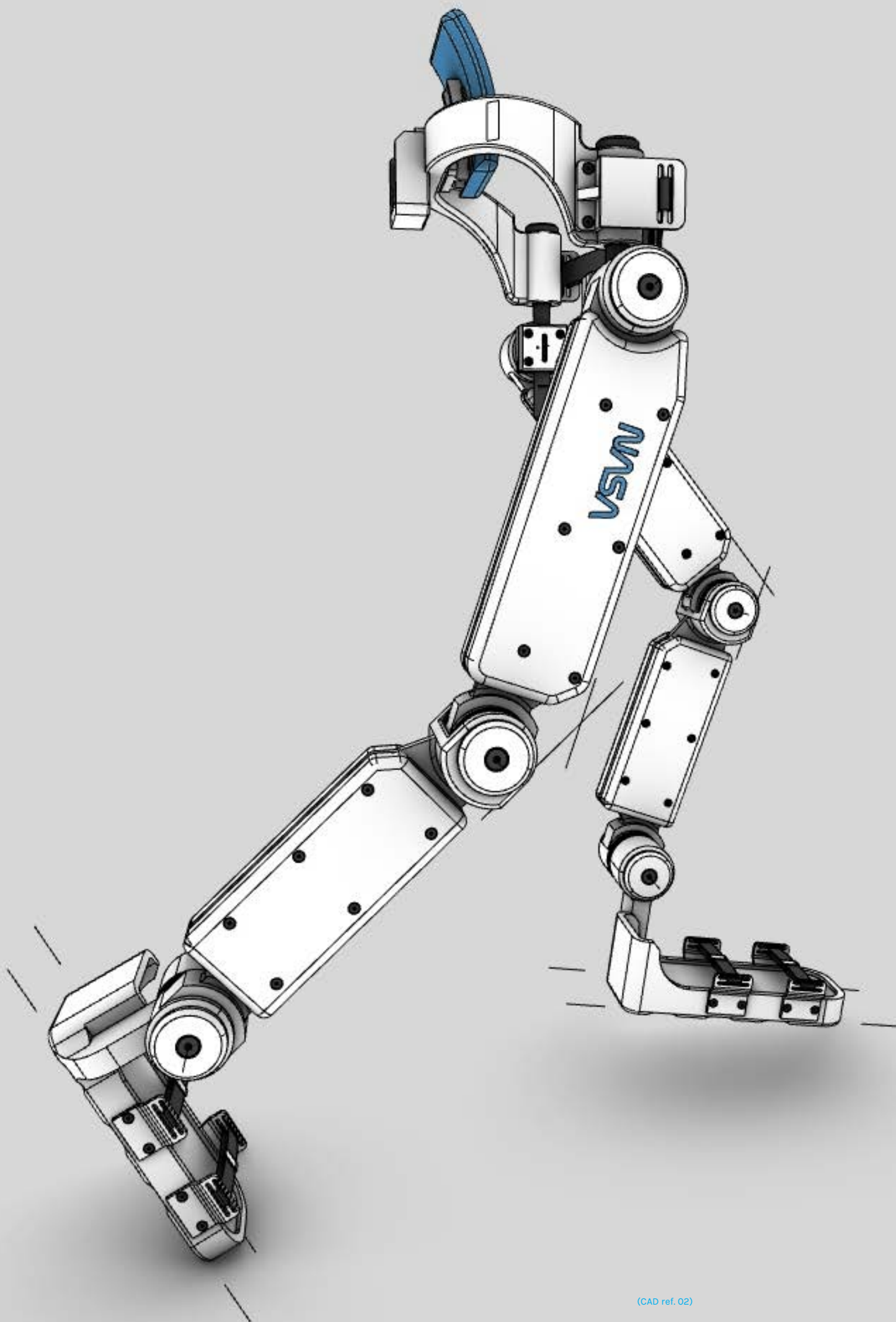
00 // Overview

Styles

This chapter offers a collection of visualization styles entirely created in Rhino.

To open the example files, follow these simple steps:

1. Open the .3dm file from associated style folder e.g. "Files/Style_K/Style_K.3dm"
2. If asked by Rhino - update the file path for all required image textures e.g. "Files/Style_K/Textures"
3. Import all required Display Mode .ini files e.g. "Files/Style_K/Display_Modes/Style_K_DM1"



08 Styles

01 // Stile A

Recommendation

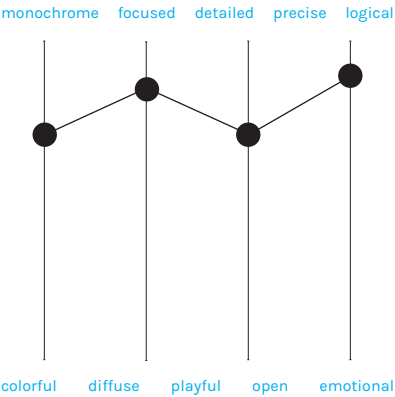
- Product visualization
- Architectural visualization
- Pictograms

Characteristics

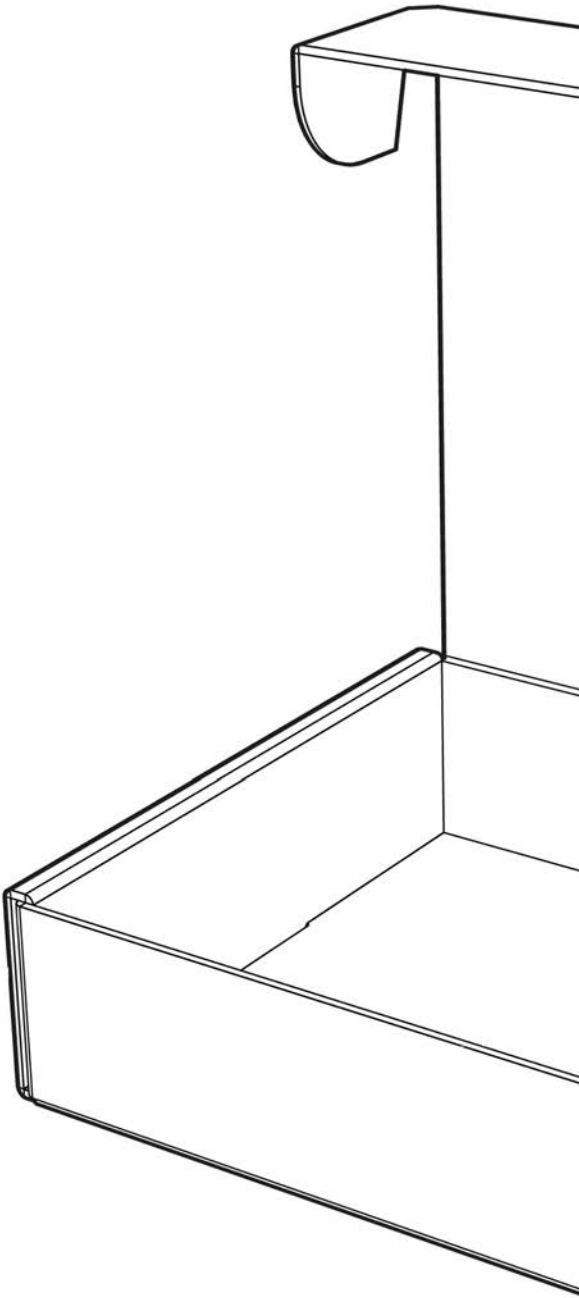
- low dynamic
- focused
- black outlines
- emphasis on silhouette
- abstract / no materiality
- no object shading
- no ground shadows
- no isocurves
- objective
- informational

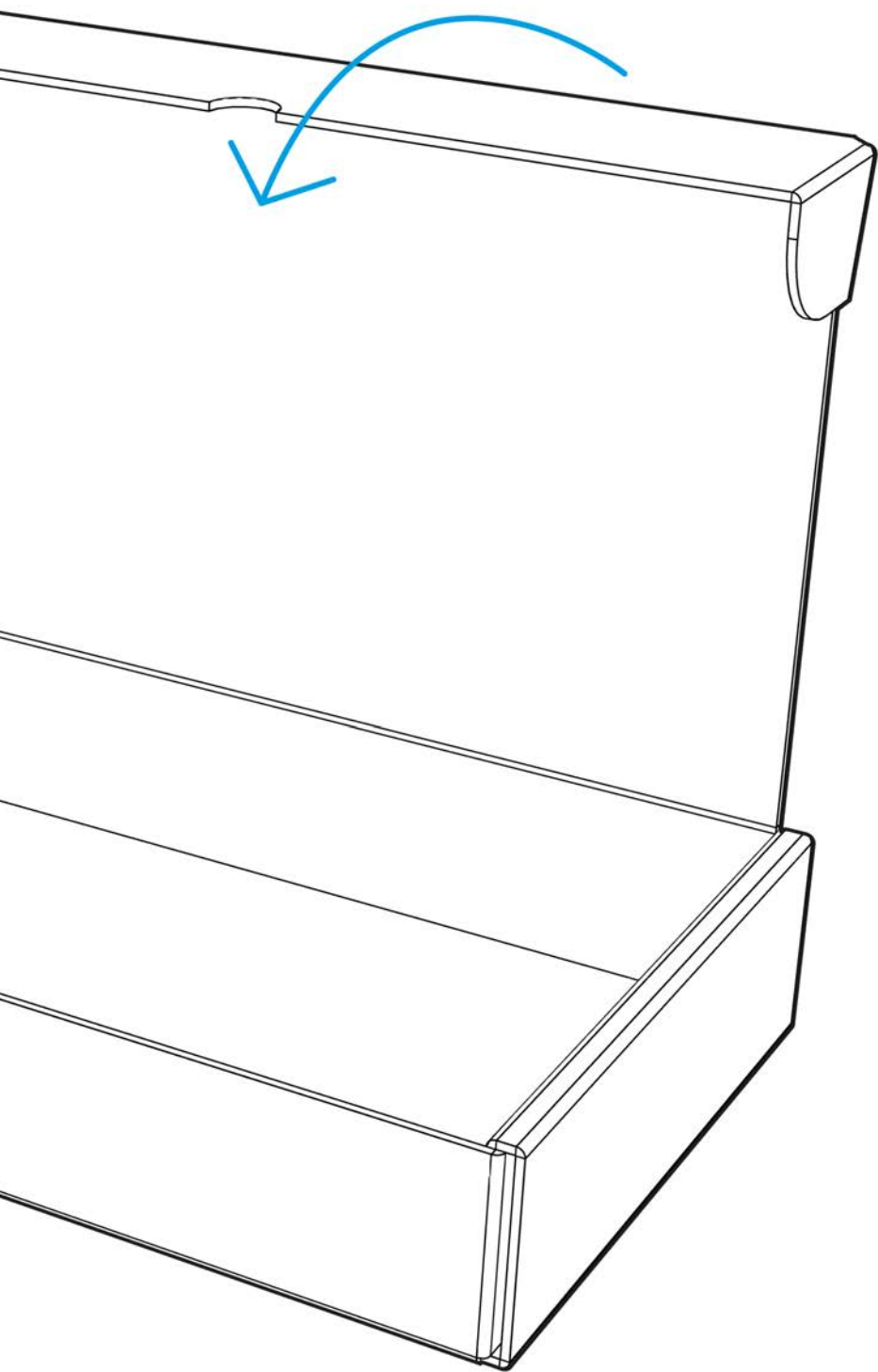
Package

- Style_A.3dm
- Display_Modes/Style_A_DM.ini



(CAD ref. 05)
(Inspiration 02 - Sushant Vohra)





08 Styles

02 // Stile B

Recommendation

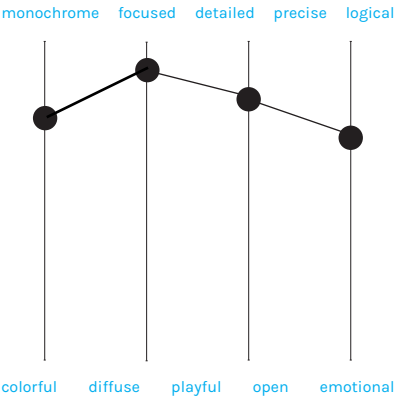
Product visualization
Informational graphics

Characteristics

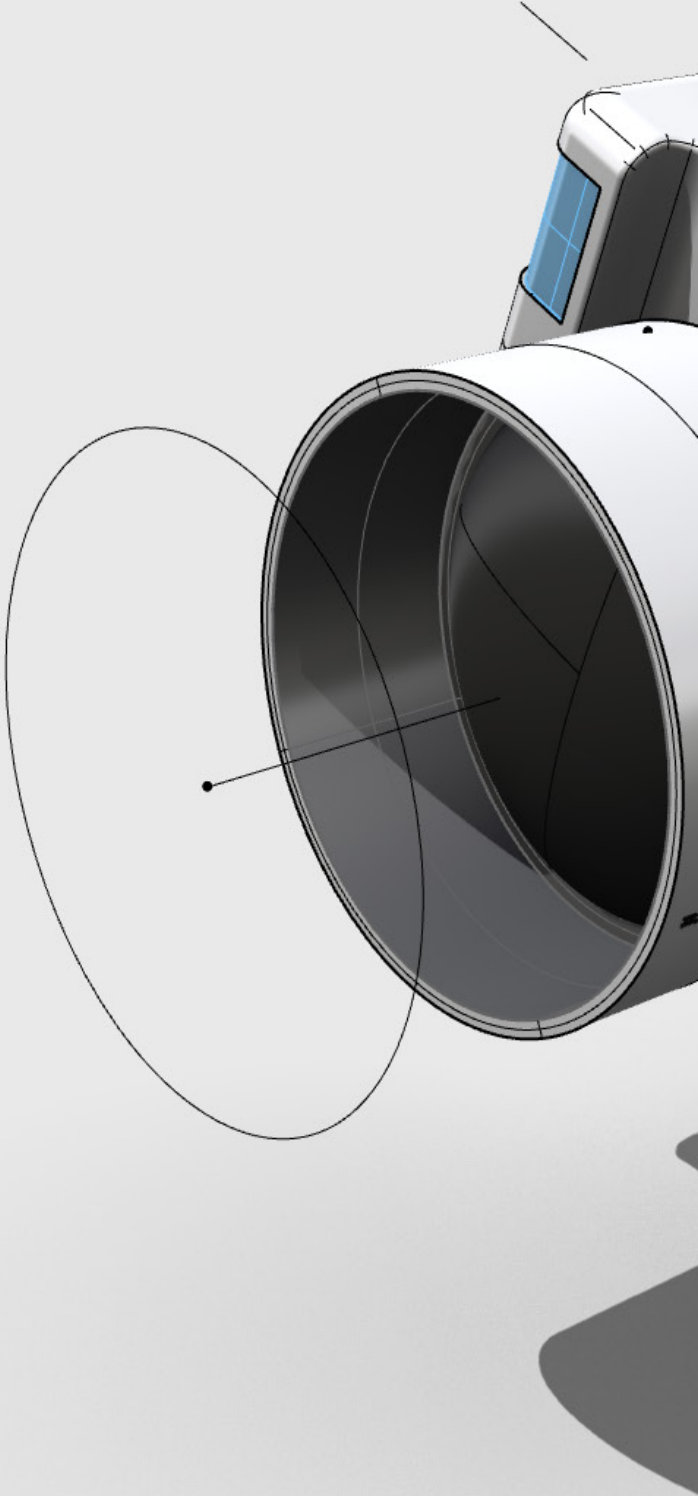
- dynamic
- strong perspective / focal length
- graphic representation
- focused
- black outlines
- abstract / no materiality
- light object shading
- strong floor shading
- no isocurves
- construction Lines

Package

Style_B.3dm
Display_Modes/Style_B_DM.ini



(Inspiration 02 - Sushant Vohra)





Recommendation

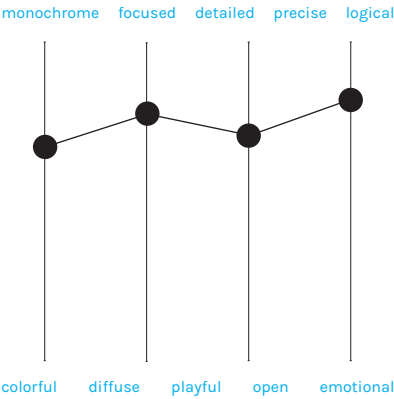
Pictograms
Product visualization

Characteristics

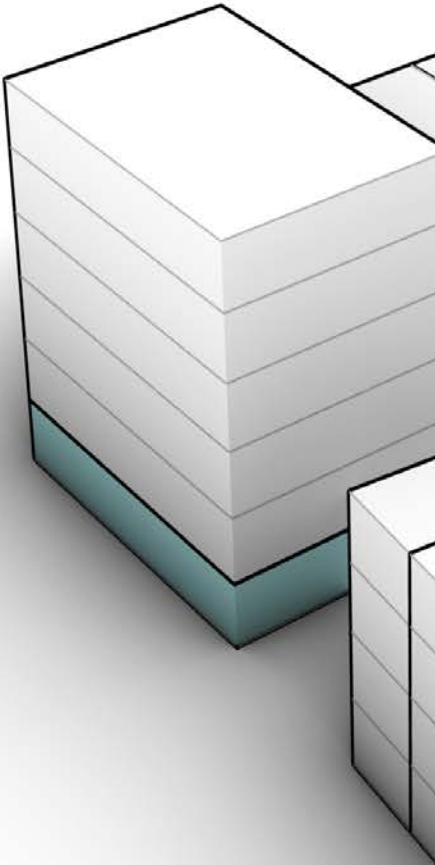
- low dynamic
- focused
- black outlines
- accent on silhouette
- abstract / no materiality
- object shading
- strong ground shadows
- no isocurves
- objective

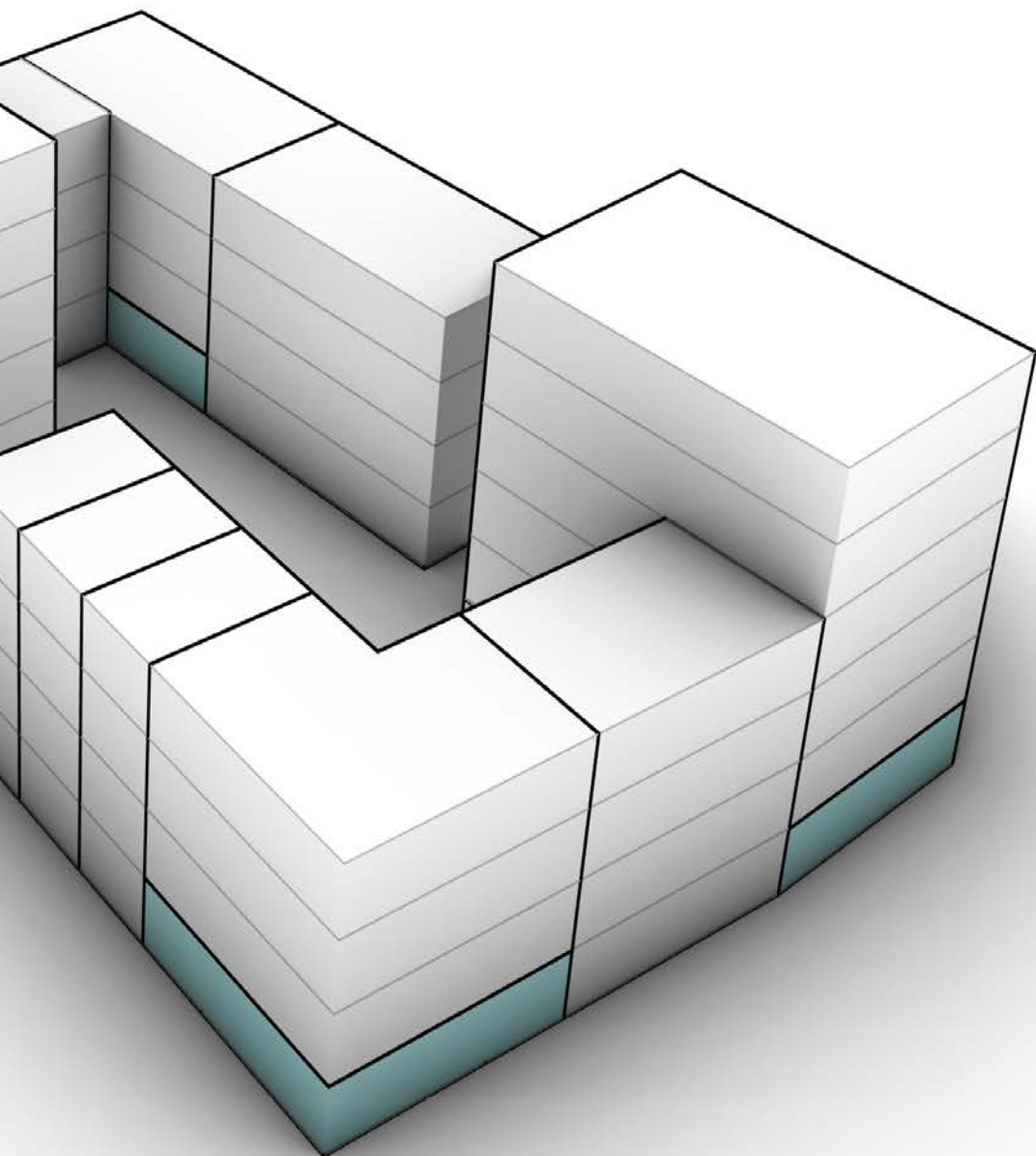
Package

Style_C.3dm
Display_Modes/Style_C_DM.ini



(Inspiration 03 - Studio-wessendorf)





08 Styles

04 // Stile D

Recommendation

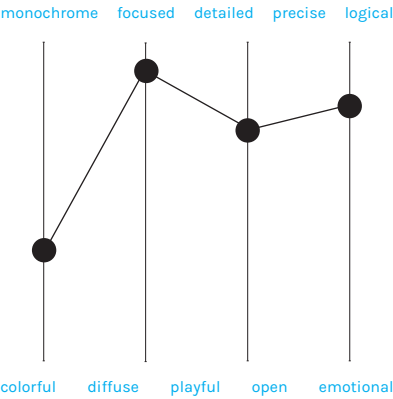
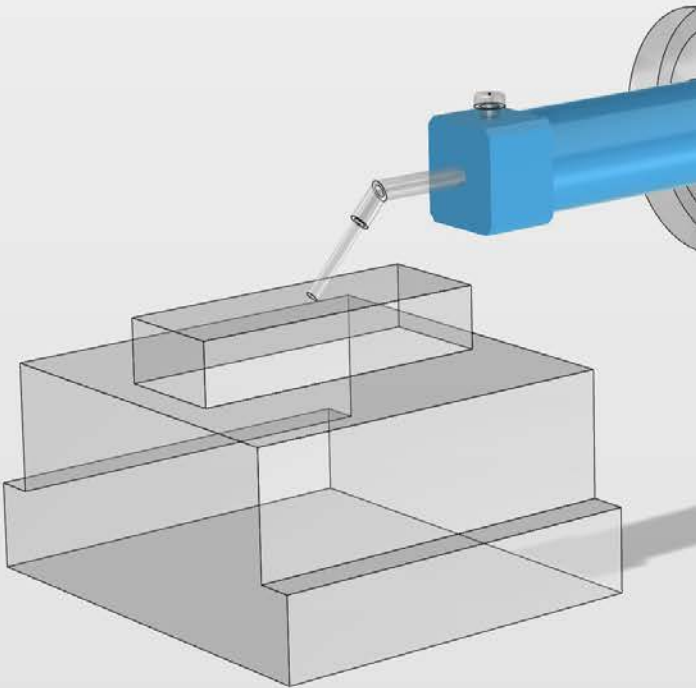
Product visualization

Characteristics

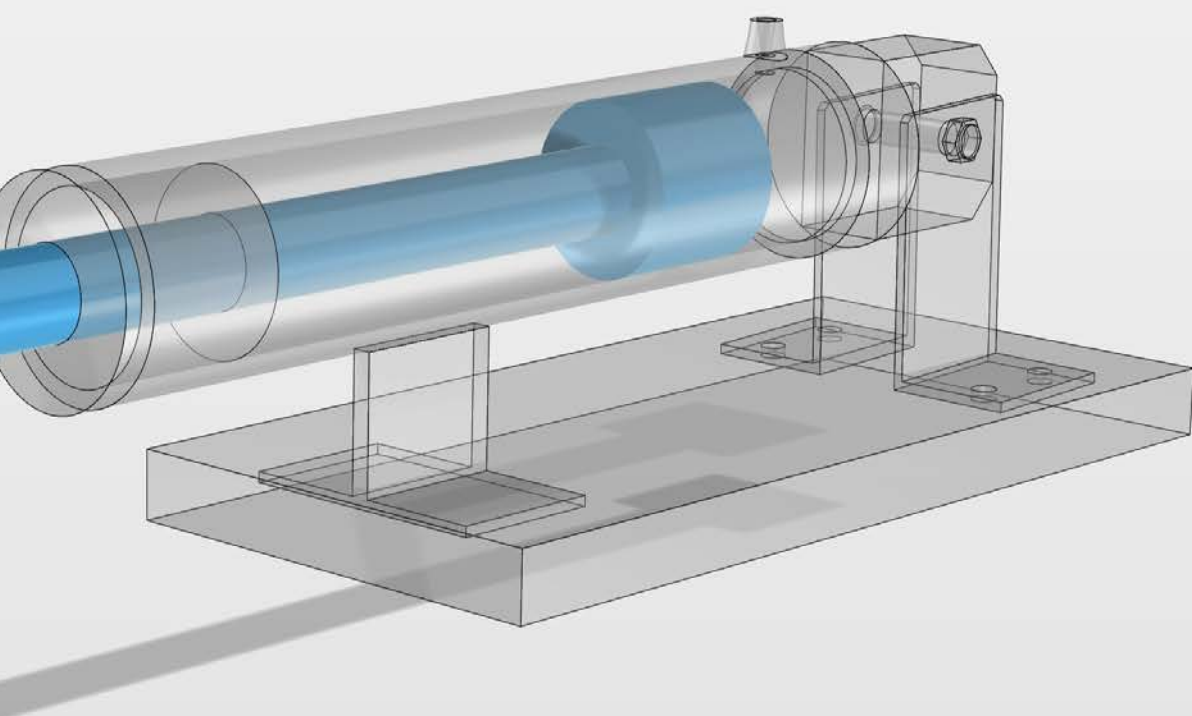
- static
- partially transparent
- focused
- black outlines
- partial materiality
- light object shading
- strong floor shading
- technical
- high information quality

Package

Style_D.3dm
Display_Modes/Style_D_DM.ini



(CAD ref. 11)
(Inspiration 04 - CAD Schroer)



08 Styles

05 // Stile E

Recommendation

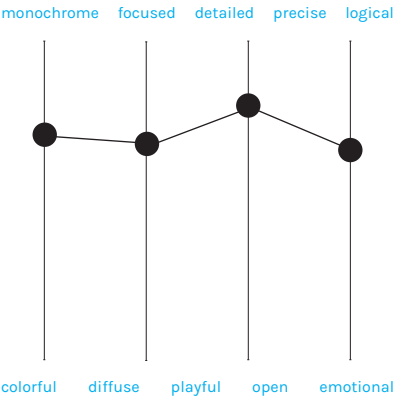
Product drawings
Architectural drawings

Characteristics

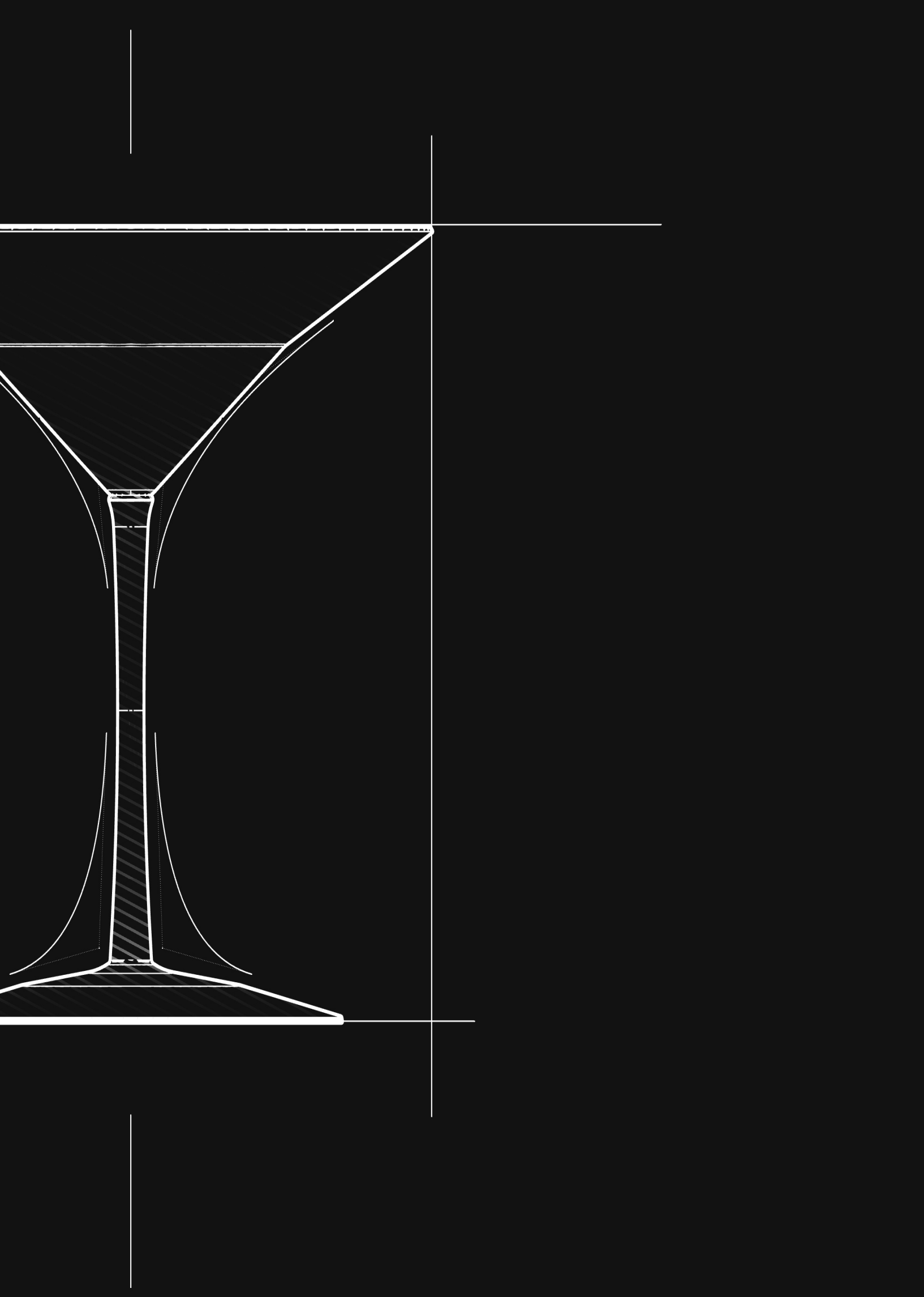
- technical appearance
- white outlines
- no object shadow
- no ground shadow
- abstract / no materiality
- object shadow
- functional
- focused
- construction lines

Package

Style_E.3dm
Display_Modes/Style_E_DM.ini



(CAD ref. 06)
(Inspiration 05 - iCanvas)



08 Styles

07 // Stile F

Recommendation

Product Blueprints

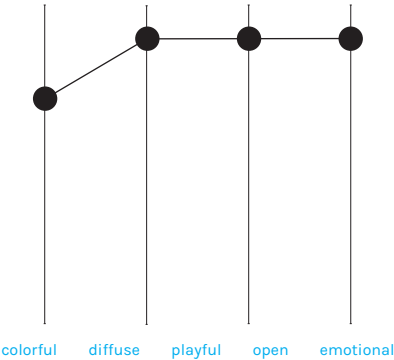
Characteristics

- very technical
- high information content
- dimensions
- abstract / no materiality
- object shading
- no ground shadows
- different views
- objective / neutral
- precise
- additional information

Package

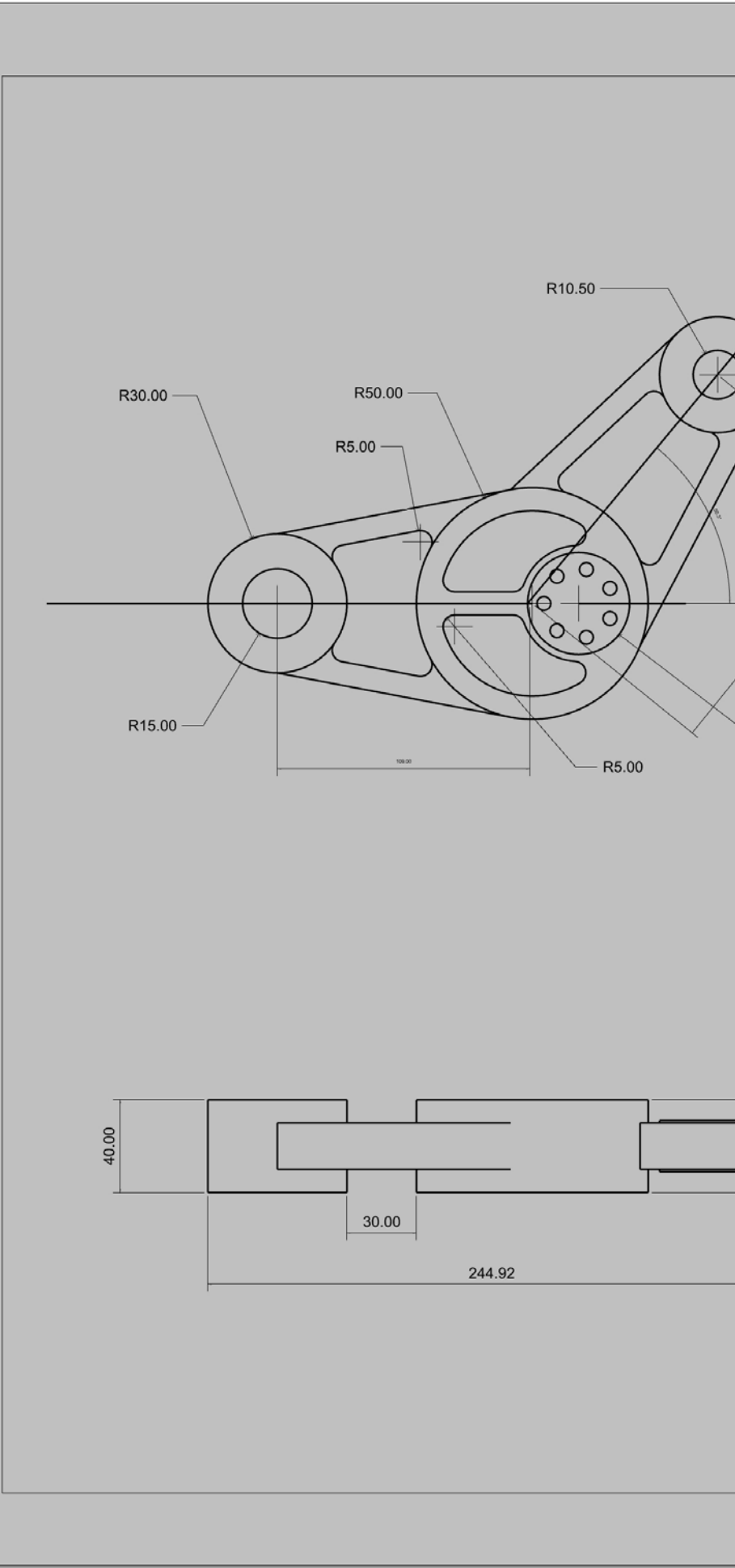
Style_F.3dm

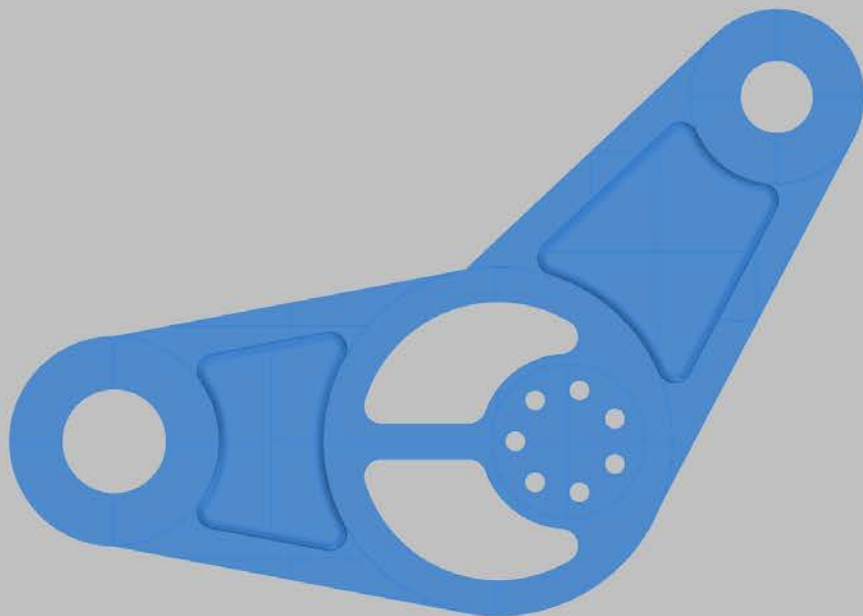
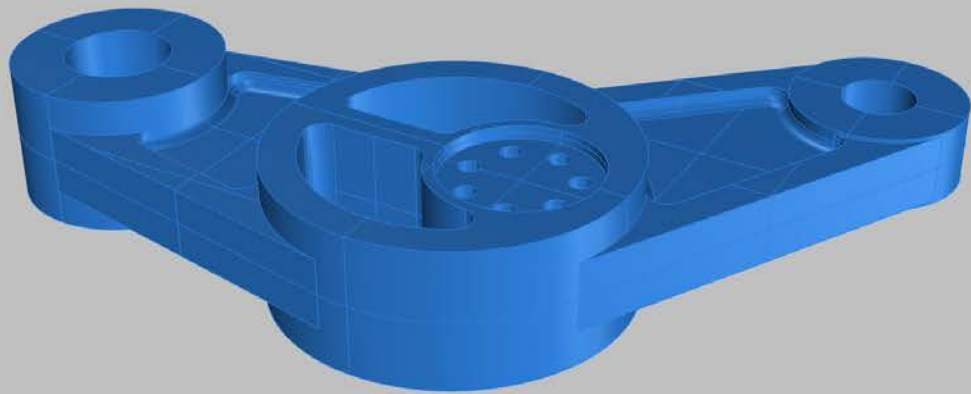
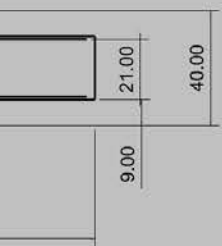
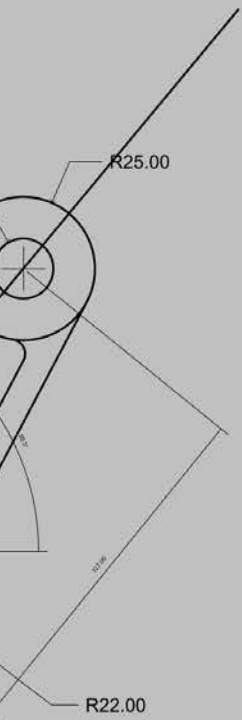
monochrome focused detailed precise logical



(CAD ref. 08)

(Inspiration 07 - Aakash Nagwani)





08 Styles

08 // Stile G

Recommendation

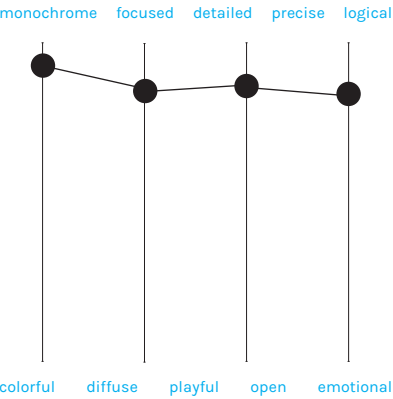
- Architectural plans
- Product explosions
- Product assembly

Characteristics

- technical representation
- bright outlines
- no object shadow
- no ground shadow
- abstract / no materiality
- objective
- focused
- construction lines

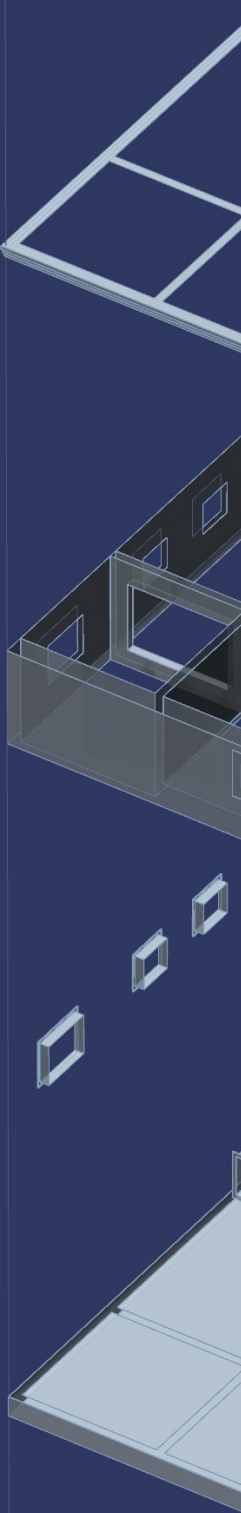
Package

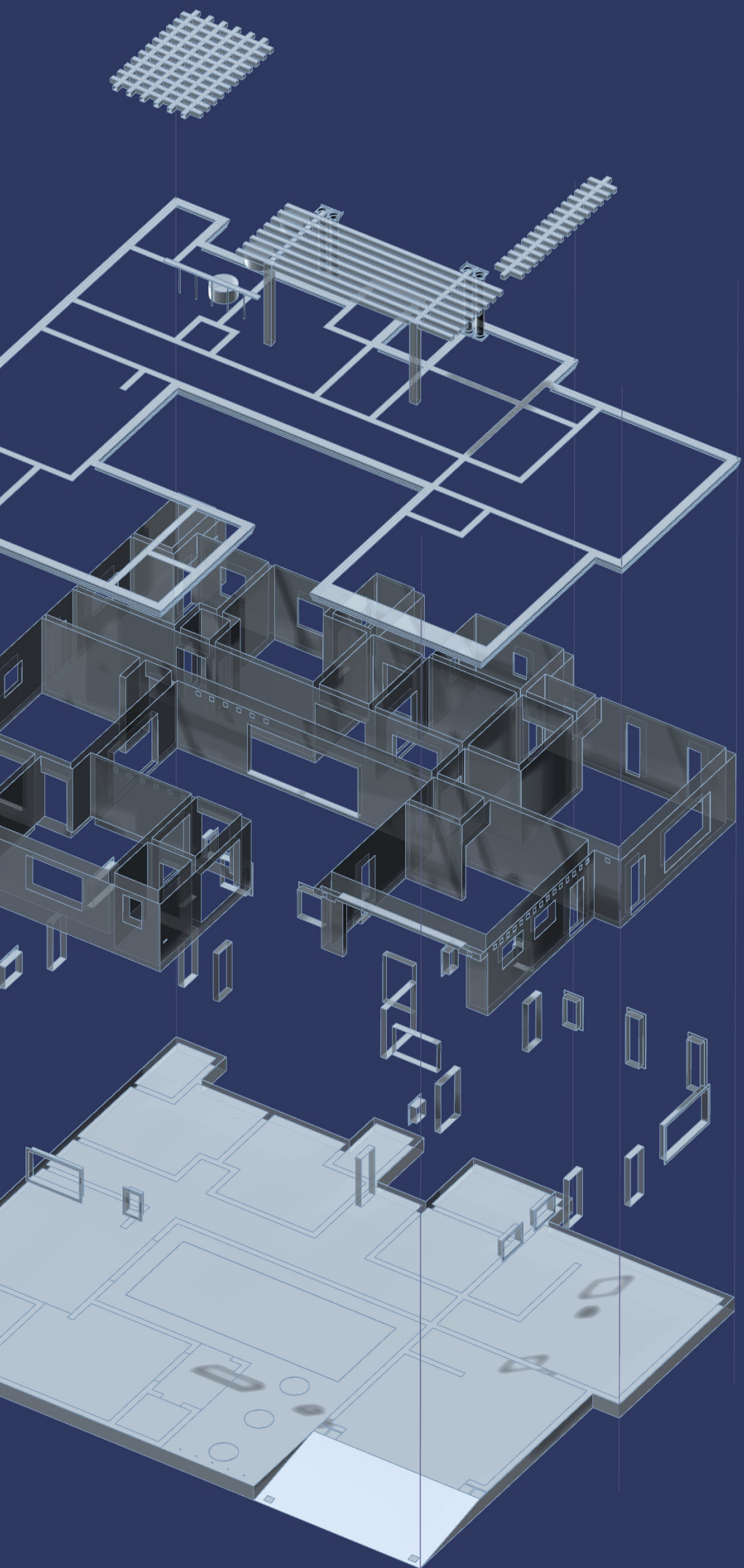
- Style_G.3dm
- Display_Modes/Style_G_DM.ini



(CAD ref. 09)

(Inspiration 08 - Shervin Sheikh)





08 Styles

09 // Stile H

Recommendation

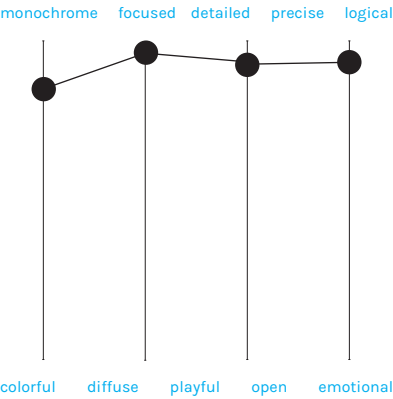
- Architectural scenes
- Blueprints
- Plan visualization

Characteristics

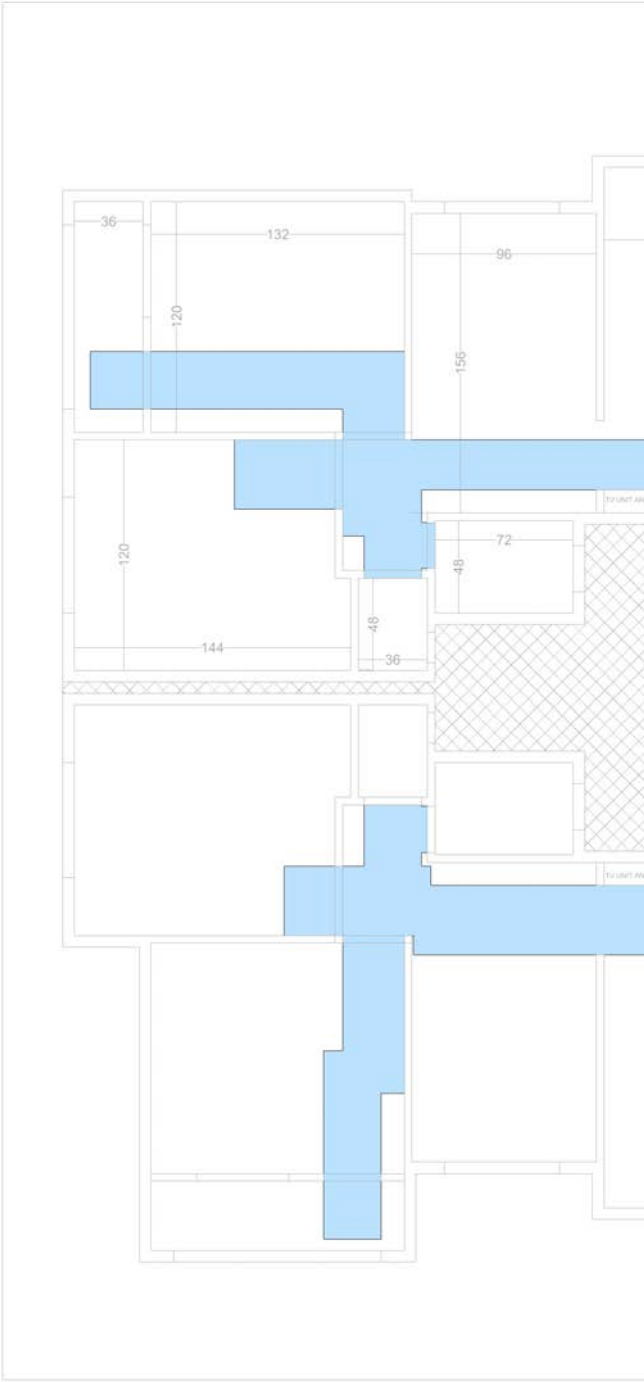
- neutral appearance
- technical layout
- precise
- informational
- no materiality
- no shades
- possibly several views

Package

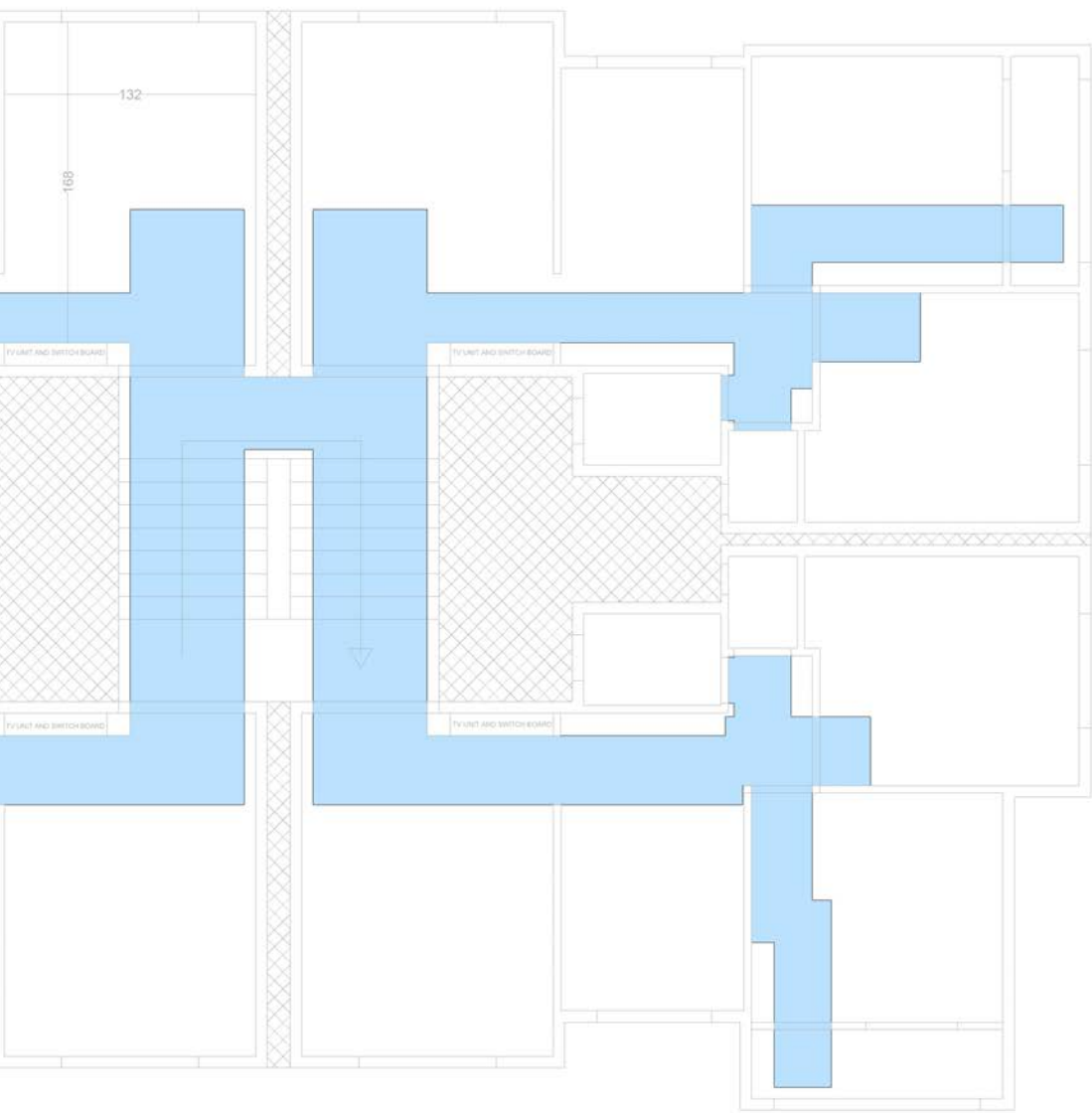
- Style_H.3dm
- Display_Modes/Style_H_DM.ini



(CAD ref. 10)
(Inspiration 09 - Gehlarchitects)



COMPLETE 2 FLOOR PLAN



08 Styles

10 // Stile I

Recommendation

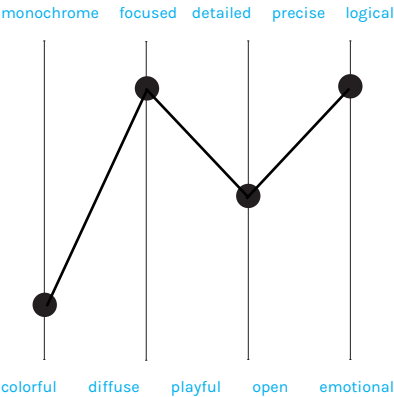
Architectural visualization

Characteristics

- textured
- flat-shaded
- soft
- precise
- informational

Package

Style_1.3dm
Display_Modes/Style_1_DM.ini
Textures/archVizTex.png





08 Styles

11 // Stile J

Recommendation

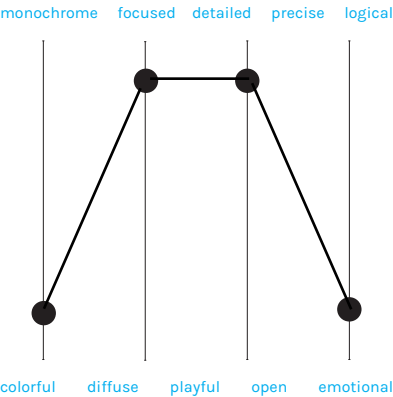
Architectural Scenes
Storytelling

Characteristics

strong lighting
strong contrast
textured
dramatic
monochrome
storytelling

Package

Style_J.3dm
Display_Modes/Style_J_DM_1.ini
Display_Modes/Style_J_DM_2.ini
Textures/birds.png
Textures/bushes.png
Textures/concrete_worm_color.jpg
Textures/tree.png



(Inspiration 12 - Fer Neyara)





08 Styles

06 // Stile K

Recommendation

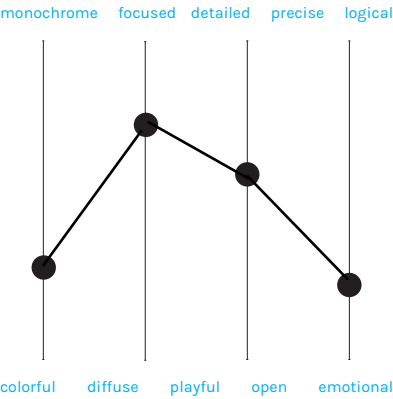
Interior visualization
Architectural visualization

Characteristics

strong lighting
textured
shadows
materiality
neutral

Package

Style_K.3dm
Display_Modes/Style_K_DM.ini
Textures/concrete_spotted_Base_Color.jpg
Textures/muslin_fabric_Base_Color.jpg
Textures/wood_mahogany_Base_Color.jpg





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http://docs.mcneel.com/rhino/6/training-level1/de-de/Default.htm#topics/_copyright_page.htm%3FTocPath%3D_____2

Revision: 03.12.2019

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(CAD ref. 02) <https://grabcad.com/library/exoskeleton-nasa-challenge-1>

(CAD ref. 03) <https://grabcad.com/library/vrz-1-2-3d-printed-bike-1>

(CAD ref. 04) <https://grabcad.com/library/camera-111>

(CAD ref. 05) <https://grabcad.com/library/corrugated-cardboard-box-1>

(CAD ref. 6) <https://grabcad.com/library/martini-glassware-bone-industries-1>

(CAD ref. 7) <https://grabcad.com/library/sony-xperia-1-ii-1>

(CAD ref. 8) <https://grabcad.com/library/control-arm-25>

(CAD ref. 9) <https://grabcad.com/library/house-project-3>

(CAD ref. 10) <https://grabcad.com/library/my-house-plan-1>

(CAD ref. 11) <https://grabcad.com/library/surface-roughness-testing-equipment-1>

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<https://grabcad.com/>

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Inspiration 01 - Kevin Harald Campean (2020, Dezember)

<https://inhabitat.com/new-life-saving-first-aid-kit-looks-like-it-was-designed-by-apple/>

Inspiration 02 - Sushant Vohra (2020, Dezember)

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Inspiration 06 - Robert Peciura (2020, Dezember)

<https://www.behance.net/gallery/70300015/Oppo-Technical-Renders-2017>

Inspiration 07 - Aakash Nagwani (2020, Dezember)

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Inspiration 08 - Shervin Sheikh (2020, Dezember)

<https://www.pinterest.de/pin/694258098804429195/>

Inspiration 09 - Gehl Architects (2020, Dezember)

<https://www.pinterest.de/pin/331859066270461025/>

Inspiration 10 - Tishk Barzanji (2021, January)

<https://trendland.com/retro-futuristic-illustrations-by-tishk-barzanji/>

Inspiration 11 - Fer Neyra (2021, January)

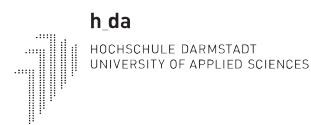
<https://www.behance.net/ferneyra>

Inspiration 12 - Fer Neyra (2021, January)

<https://www.behance.net/gallery/59774217/Casa-Colgada>

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VISUALIZATION IN RHINO

Max Stein, Gabriel Rumpf, Tom Philipps, Markus Schein

Whether you need early-stage illustrations or high-end renderings, Rhino offers a variety of possibilities for visualization in different stages of the development process. However, learning 3D Software can be a daunting experience. This book aims at teaching you the basics on the subject of visualization in Rhino by covering the following areas:

Scene Management
Camera Setup
Lighting
Coloring and Materials
Display Modes

The teaching material includes step-by-step explanations as well as examples for rendering applications in different contexts, such as product and architectural visualization.

This project was kindly supported by digiLL, a university network that promotes digital education.

