The principles of CCTV design in VideoCAD

Part III 3D modeling in VideoCAD

Edition for VideoCAD 7

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In the first part of the article, we have considered modeling of a camera view area and the order of a simple project creation. In the second part, we have considered how in VideoCAD a person detection area, person identification area, license plate reading area and spatial resolution are automatically calculated for each camera in the project. In the third part, we will consider means for 3D modeling of camera images.

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Advantages of 3D modeling in CCTV design

Three-dimensional models of video images are not a required part of CCTV project, two-dimensional layout can contain all information necessary for CCTV system installation. Using VideoCAD tools, it is convenient to choose positions and parameters of cameras, to work with view area projections, etc. on the two-dimensional layout. However, the opportunity of three-dimensional modeling of images is extremely useful at design and project negotiation stages.
Using three-dimensional modeling, it is possible to solve problems, arising during design, in the best way, taking into account complex factors. For example, in two dimensions, it is difficult to take into account obstacles closing a part of a view area and peculiarities of displaying three-dimensional objects.
Three-dimensional modeling allows to see even at design stage the output information of CCTV system - images on monitors. This information will protect against expensive mistakes and will allow to choose arrangement and parameters of equipment with high level of accuracy, and to find new unusual solutions for stated problems.

Modeling of images on monitors in real scale and quality can assist in choice of necessary quantity and parameters of monitors, and also in designing an operator's workplace. In fact, not less than two kinds of images from each camera are in the output information of CCTV system. Each kind of image has generally different details. The image of the first kind is recorded in memory and can be used for the subsequent analysis. The image of the second kind is watched by an operator during live monitoring. On a multiscreen monitor, this image can have a small size and details. VideoCAD allows to model both recorded image from each camera, and multiscreen monitors as a whole.

3D modeling can considerably simplify work during CCTV system design for a building, which is a project itself.

Modeling of images makes communication with a customer much more productive. Models of images are more informative for non specialist, than only a camera placement layout with view area projections. Three-dimensional models of images allow communicating with a customer in mutually understandable language, demonstrating advantages of offered project at comparison of a competitor's project as well as avoiding disappointments because of limited image resolution.
The substantiation of the project becomes simpler: from quantity and placement of cameras and monitors up to qualitative parameters of equipment. It is obvious also, that the project with models of images on monitors has a competitive advantage in tenders.

Principles of three-dimensional modeling in VideoCAD

3D modeling tools available in VideoCAD are intended for maximum precise CCTV system design with the minimum efforts. VideoCAD performs routine work and offers creative part for a designer.

VideoCAD does not demand special knowledge of 3D modeling from a designer.
Actually, the designer should not work in 3D space, all constructions are carried out on usual plane. However, in such a way the 3D model of environment can be created simply and quickly with sufficient details for CCTV project.

There are no complex tools for modeling optical properties of materials, various three-dimensional visual effects, etc. in VideoCAD. However, everything concerning cameras and modeling of their images in view of resolution, sensitivity and typical distortions in CCTV systems is available.

Very often, it is necessary to see how a person, a car or other complex object will be displayed on screen. For this purpose, VideoCAD contains library of ready 3D models. It is possible to enrich this library independently.

Because of the fact that 2D layouts are usually used in CCTV design, VideoCAD offers tools for fast transition from 2D layout to 3D model.

There are tools to model full-scale multi screen monitors with images from several cameras.
It is possible to model depth-of-field and limited visibility using known meteorological optical range, which can be received from a weather report.
It is possible to model images from cameras in low light condition, taking into account camera and lens parameters and also parameters of illumination and luminaries including discharge lamps and IR illuminators.
It is possible to simulate distortions of moving objects, depending on camera's parameters and creating animated images.

** Modeling depth-of-field, illumination, camera sensitivity and moving objects is beyond the scope of the article and merit detailed consideration. You can find all necessary information including examples in the Help system.*

As well as the previous parts of the article, this part acquaints only with the basic capabilities of the program. To study deeper, it is necessary to address to the Help system.

* *Tools are described according to the version VideoCAD 7.0.*

Practical example of three-dimensional modeling

Let's examine in a practical example, creation of separate camera images models and models of the images on monitor during designing.

Let us suppose, we have two-dimensional layout of a building with 4 cameras placed preliminarily according to the information from the first part of this article (**Fig. 1**). On the layout we see, what areas will be covered by each camera. Separate lines mark projections of person detection and identification areas.

Using the tools described below we will be able to see images, which will be recorded by system, and the image on the screen.

* *Start of work with the VideoCAD software, work with background, placing and setting parameters of cameras is described in details in the first part of the article.*

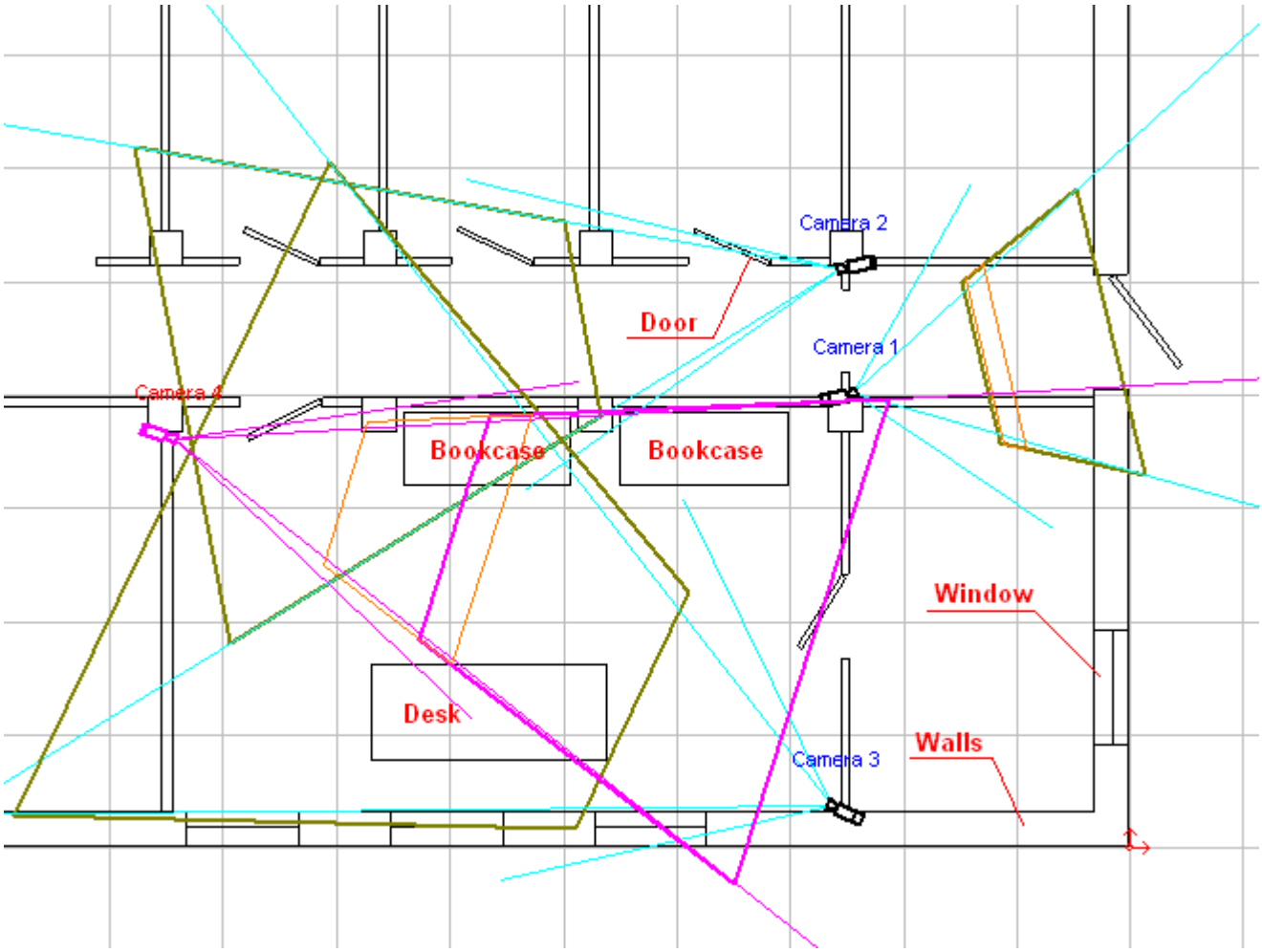


Fig. 1. A site of an object with placed cameras. Camera 4 is selected.

There are walls, doors, a desk, bookcases, windows on the layout.

We know the vertical sizes of objects:

Height of walls – 3m;
Height of doorways - 2.2m;
Height of the desk – 0.75m;
Height of bookcases-2m;
Window apertures are from 0.7m up to 2m.

Creation of three-dimensional model of environment on two-dimensional layout

For creation of three-dimensional constructions VideoCAD offers the following tools (**Fig. 2**):

point , **horizontal line** , **vertical line** , **line segment** , **polyline** , **angle** , **rectangle** , **inclined rectangle** , **double line** , **wall** , **aperture in wall** , **circle** , **arc** .

In 3D space this constructions are stretched throughout the height and become 3D objects.
For example, a line turn into a vertical rectangle, a point – into a vertical segment, rectangle – into a parallelepiped, circle – into a cylinder, etc.

To create 3D model it is necessary only to draw out the objects on the background (walls, doors, windows, etc.) by constructions, setting values of the third coordinates (heights).

All actions are carried out on plane in the **Graphics window**.

The minimal and maximal heights, and also color of obtained 3D objects are initially set by parameters of **line type** by which construction is drawn.
The heights can be set separately for each object, both during constructing, and editing by means of **Current construction parameter panel** (**Fig 2**).
Color of constructions is defined only by **line type**, which is used at constructing.

* *The **Current construction parameter panel** appears in the bottom of the **Graphics window** together with the **Line type panel** in the moment of drawing or editing the constructions.*
*In other cases the **Current construction parameter** panel disappears.*

* *More about constructions see the Help system: **Interface> Graphics window> Toolbar> Tools list> "Constructions" button group**.*

In our simple example we will use only one tool - **Rectangle** .

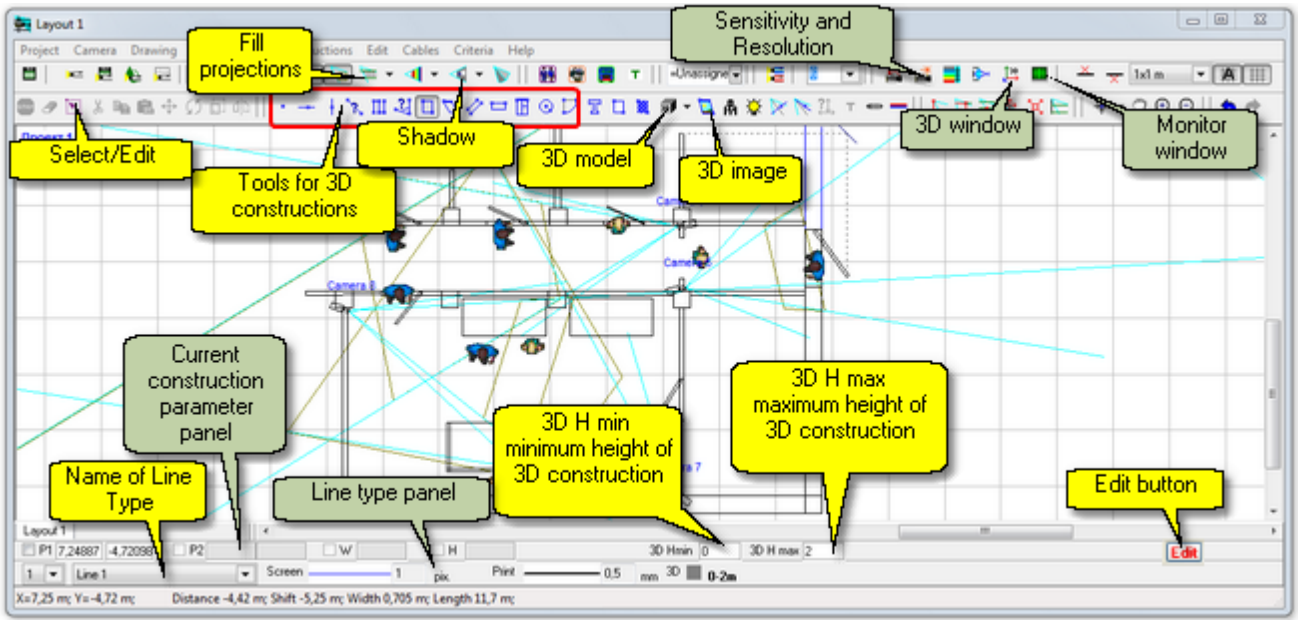


Fig. 2. The basic tools for three-dimensional modeling in the Graphics window.

Setting line types

First of all, we will set parameters for separate line types for walls, desk and bookcases.

** The **line type** in this example will define the color and default values of the vertical sizes of 3D objects constructed by this line type.*

Choose **Main menu>View> Options**. In the appeared **Options box** choose **Line** tab.

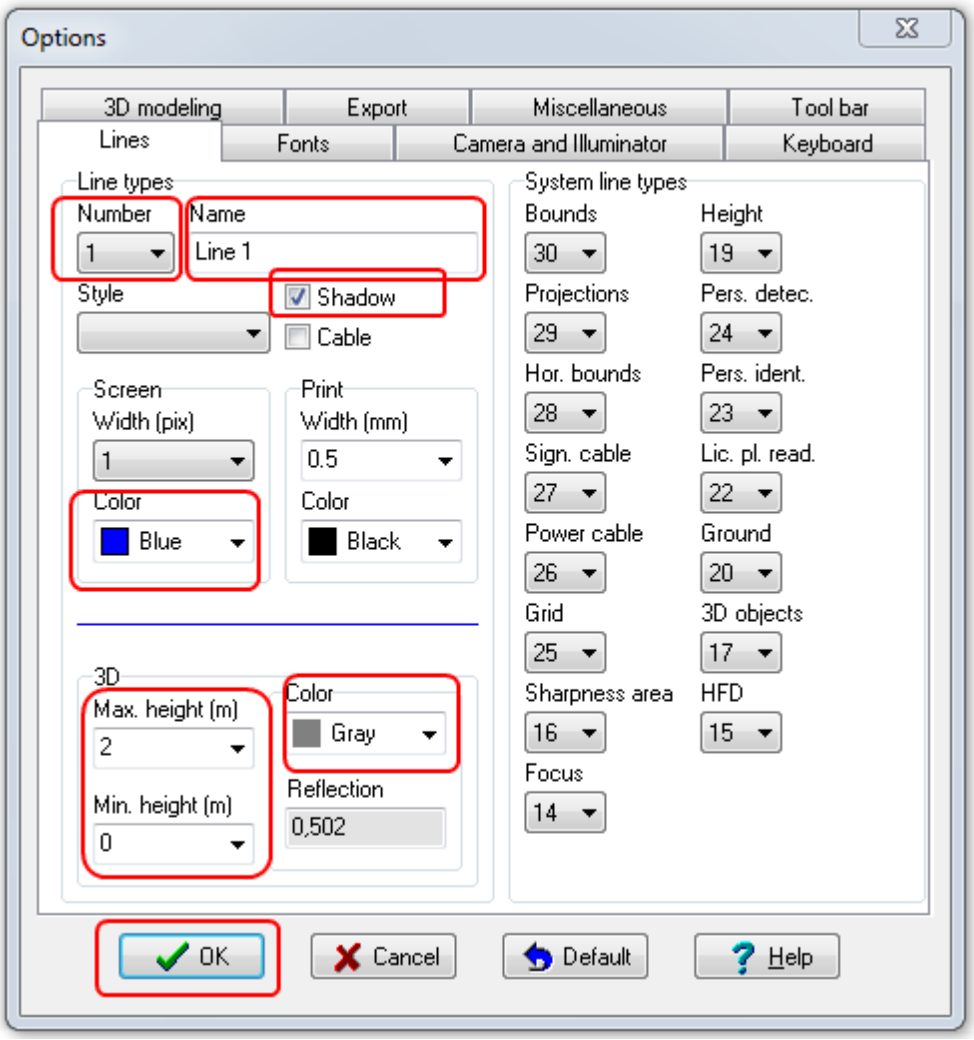


Fig. 3. Setting line types

** In the right part of the **Line** tab we see **System line types** frame. These line types with numbers 14..30 are used as system line types. For constructing it is necessary to use lines with any other numbers. For example, for walls we use a line 40, for doors - line 41, for a desk - line 42, for bookcases - line 43*

Choose "40 " in the **Number** combo box and adjust this line type (**Fig. 3**).
Type the name of this line type - "*Walls*" in the **Name** box.
The **Shadow** box should be checked in order to constructions made by this line type, is considered as obstacle in calculation of shading (see details below).
On the **3D panel**, in **Color** combo box, choose color of three-dimensional walls - "***Silver***". In the **Maximal height** box, type the height of walls known to us - 3.
For convenience of distinction of different line types on the layout, on **Screen** panel in the **Color** combo box assign color for the line in the **Graphics window** - ***"Blue"***.
Leave without changes other parameters of the line type.

* *For detailed information about parameters of line types, see the Help system:* ***Interface> Options> Lines***

Similarly, adjust lines 41, 42, 43. Name them "*Doors*", "*Desks*", "*Bookcases*".

Assign:

- For doors: the color of 3D objects - "***Olive***", the color in the **Graphics window** (Screen line color) - "***Olive***", the maximal height - 2.2;
- For the desk: the color of 3D objects - "***Teal***", the color in the **Graphics window** - "***Teal***", the minimal height - 0.73, the maximal height 0.75 (thickness of the desk equal 2 cm);
- For bookcases: the color of 3D objects "***Maroon***", the color in the Graphics window - "***Maroon***", the maximal height - 2;

Click **OK**. The **Option box** will be closed.

Construction of 3D model of the office

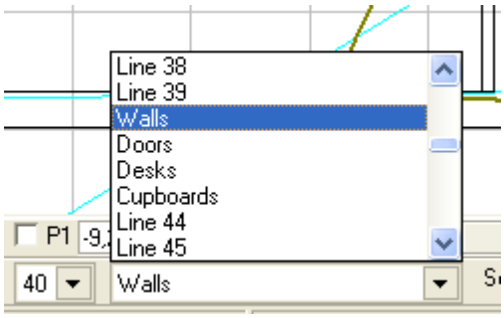
Walls with windows and doorways can be constructed in two ways:

1. Using the **Rectangle** tool only. Parts of walls under the openings between the openings and over the openings are constructed separately.
2. With two tools: **Wall** and **Aperture in wall**. This way, first with the tool wall walls without openings are constructed, and then using the Aperture in wall tool, openings in walls are made.

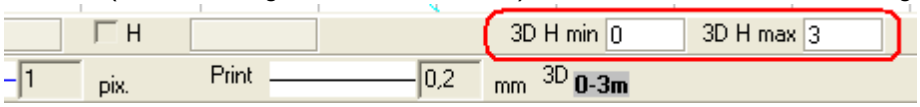
Here we consider the first way only - by using the **Rectangle** tool. Descriptions of the tools **Wall** and **Aperture in wall** you can find in the help system.

Constructing walls

Choose the **Rectangle** tool (**Fig. 2**).
On the **Line type panel**, which appeared in the bottom, in the **Line type name** combo box, choose line type, adjusted at the previous step, by which we are going to construct - "*Walls*".



On the **Current construction parameter panel**, in **3D H max** box (Maximum height of 3D construction), height of walls (3m), set by us, will be appeared. We have set this value as parameter of **Line type**. Zero value in **3D H min** box (Minimum height of 3D construction) means that walls will be on the ground.



Then simply draw out all walls and columns on the layout by rectangles. Don't draw out windows and doors. (**Fig. 4**).

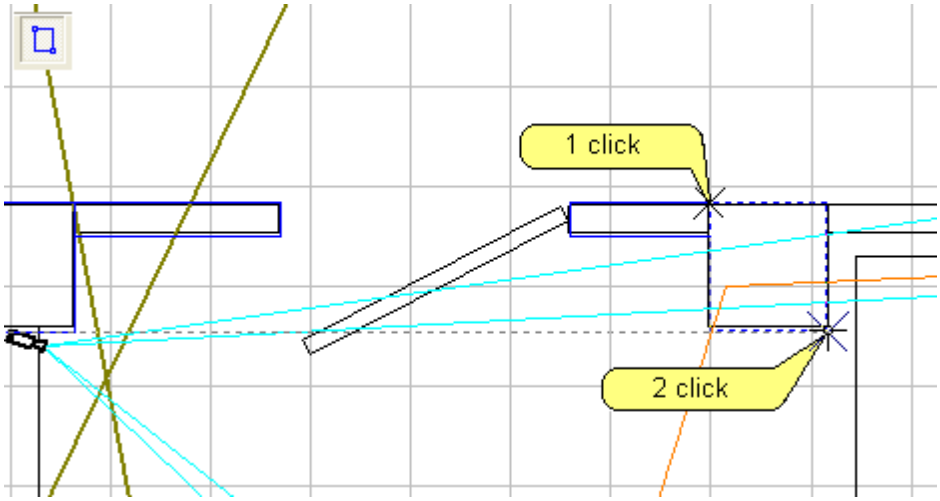


Fig. 4. Constructing walls

* *After a construction has been drawn, in the right end of the* ***Current construction parameter panel,*** *the Edit*  *button appears. Clicking this button allows editing just created construction.*

* *For convenience it is possible to supervise constructing using images from cameras. For this purpose: Activate any camera, by double click exact on its lens. Then display an image from this camera by click on the* ***3D window*** *button (**Fig. 2**).*
If on various sites of the layout we will activate cameras, which cover these sites, we can see in ***3D window*** *how our work is being done (**Fig. 5**).*

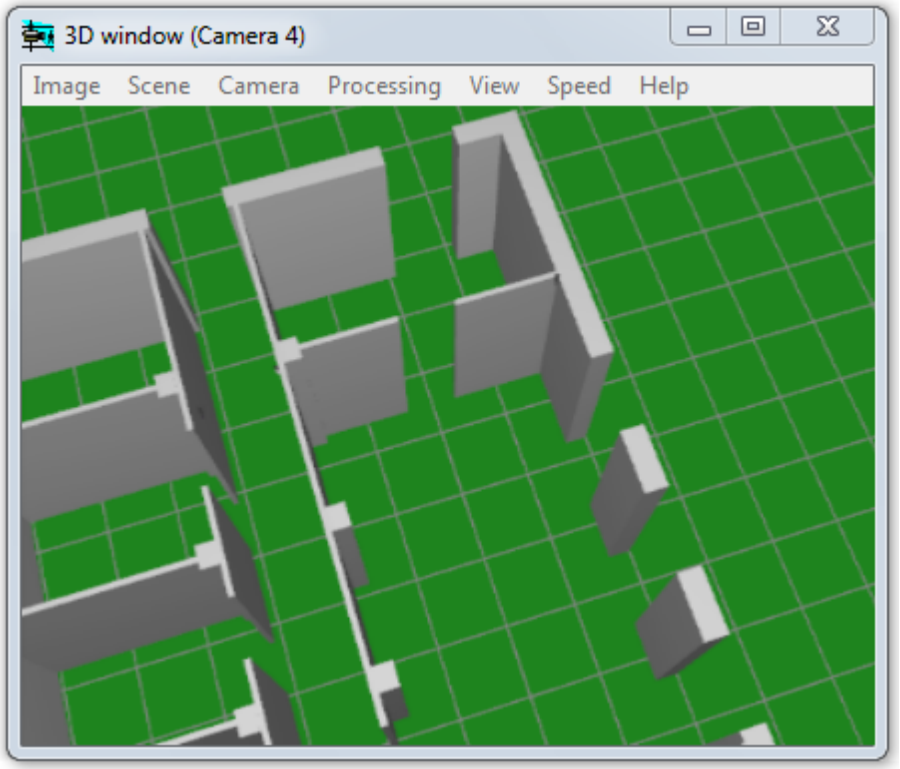
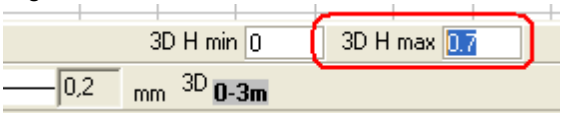


Fig. 5. Walls have been created. The view in 3D window from Camera 4 lifted on 15m. height.

Constructing windows and door apertures

A window is an aperture having two beams below and above. We will construct these beams separately. The bottom beam is on the ground and has height of window-sills - 0.7m.

For constructing the bottom beam choose **Rectangle** . Then on the **Line type panel** appeared in the bottom, in **Line type name** box, choose "***Walls***".
On the **Current construction parameter panel**, in **3D H max** box (maximum height of 3D construction), type the height of window-sills - 0.7.



Then construct rectangles in window apertures in the same way we constructed walls (**Fig. 6**).

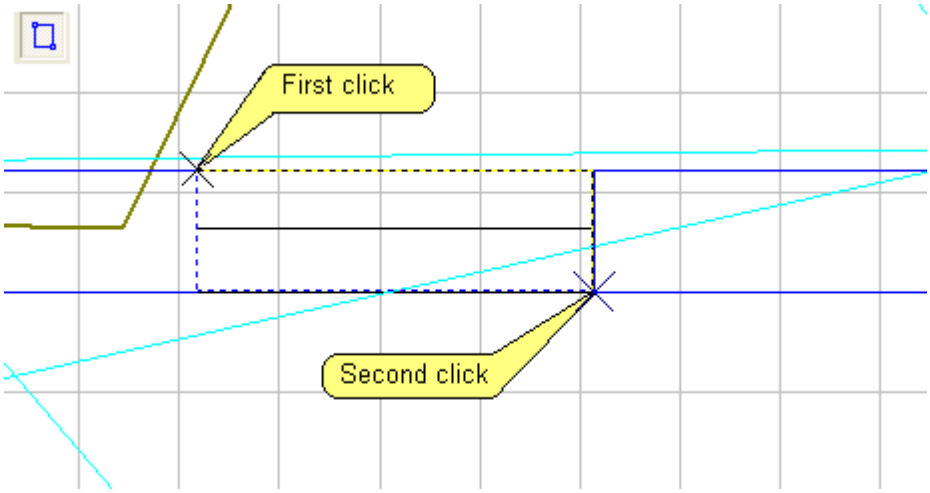
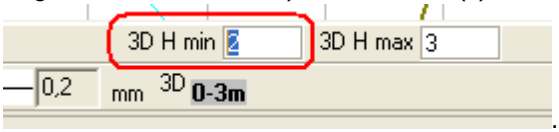


Fig. 6. Constructing windows

Similarly, construct the top beams of windows as rectangles over the bottom beams. Before constructing in **3D H min** box (minimum height of 3D construction), it is necessary to type the height of window apertures (2). In the **3D H max** box (maximum height of 3D construction) correct value (3) is set in **Line type** parameters. It is not necessary to change it



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Similarly, construct the top beams above doorways as rectangles in doorways. Type 2.2 (height of doorways) in the **3D H min** box (minimal height of 3D constructions) before constructing.

* *During creation of constructions it is possible to use **rotating** , **moving** , **copying** , **pasting** , **scaling** and **mirroring** . For use of these tools, first of all, it is necessary to **select** construction, by clicking on it in the selection mode or by the **selection window**.*

* *For editing separate construction, double click on the construction. After that, pink grips will appear at its base points. Further, it is possible to move the base points by mouse, to change **line type** and parameters of editing construction on the appeared **Current construction parameter panel**. Using this panel it is possible to set numerical values of the sizes in a similar manner as during constructing.*

* *For detailed information about selection and editing, see the Help system: **Interface> Graphics window> Tool bar>Tool list>"Constructions" buttons group>Select/Edit**.*

* *For detailed information about **Current construction parameter panel**, see: **Interface> Graphics window> Pop-up panels> Current construction parameter panel.***

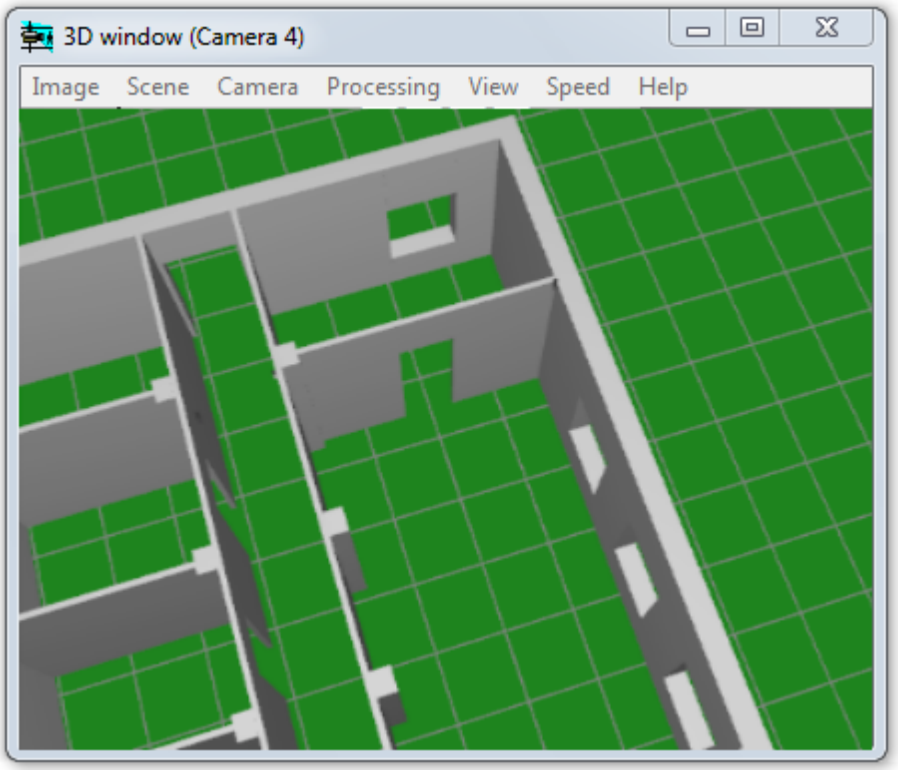


Fig. 7. Windows and doorways have been created. The view in 3D window from Camera 4 lifted on 15m. height.

Constructing bookcases and desk

For constructing desk, choose **Rectangle** again. On the **Line type panel**, in **Line type name** box, choose "*Desks*" line type .
After that, in **3D H min** box (minimum height of 3D construction) height of the bottom of the desk (0.73) will appear, in **3D H max** box (maximum height of 3D construction) height of the top of the desk (0.75) will appear. The heights we have set during adjustment **Line type 42** ("*Desks*").

Construct the desk, having drawn out the desk on the layout by rectangle. It is possible to construct legs of the desk and others small elements, using the same line type, having set values for the minimum and maximum heights on the **Current construction parameter panel**.
Similarly, construct bookcases, using "*Bookcases*" line type.

* *During constructing three-dimensional models for CCTV project it is not necessary to be keen on detailed elaboration. In most cases only a form, sizes and position of an object have value.*

Constructing doors

Doors are constructed similarly, using the line type "*Doors*", as rectangles. But we cannot construct a rotated rectangle at once. Therefore, first it is necessary to construct a horizontal or vertical rectangle, and then to select and turn it, 'having slightly opened a door' (**Fig. 8**). For rotating use the **Rotate** tool.

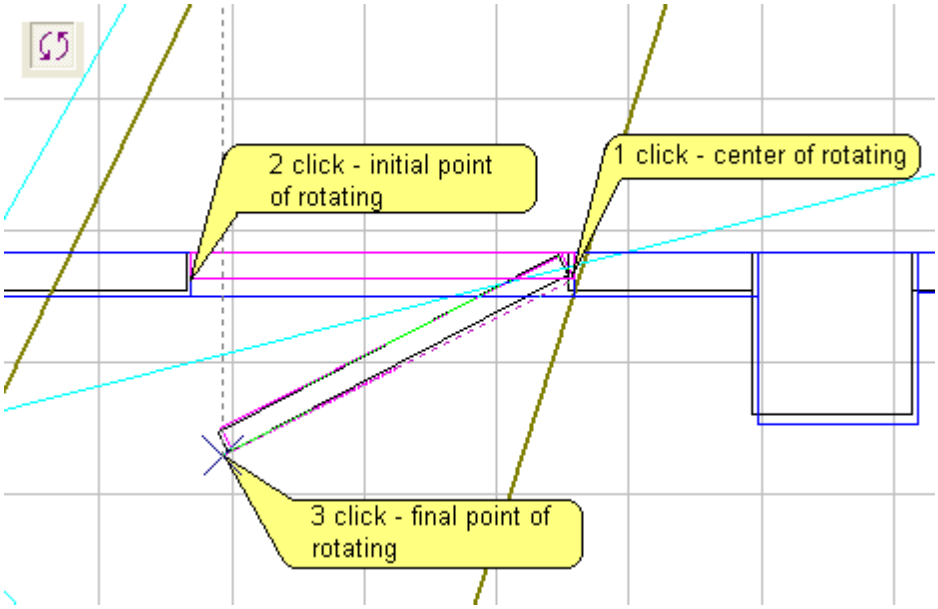


Fig. 8. Rotating door.

Placing ready 3D models

Place in necessary points three-dimensional models of persons.

For placing a model, click on the **3D model** button, then choose 3D model from the drop-down list. Then every click on the layout will result to placing chosen 3D models (**Fig. 9**).

After placing, it is possible to select and rotate the **3D model** in the necessary direction.

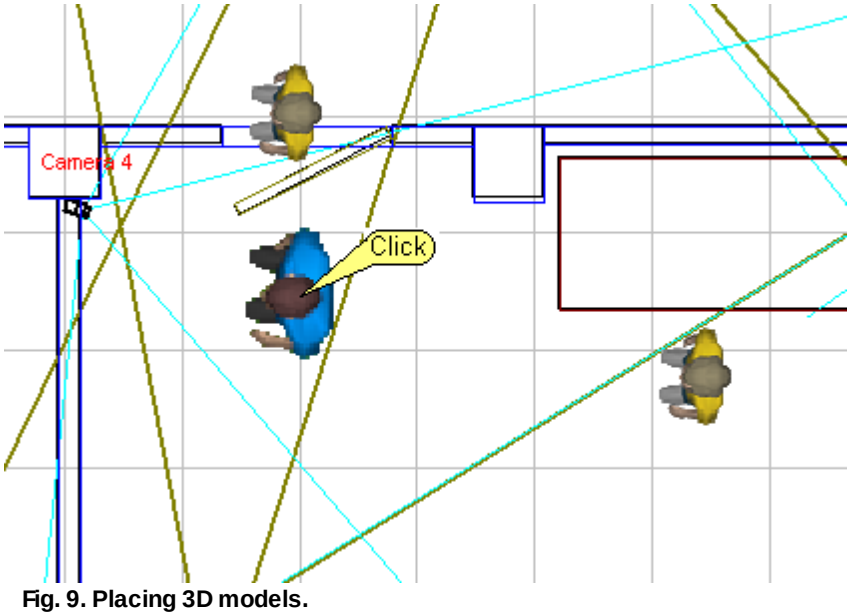
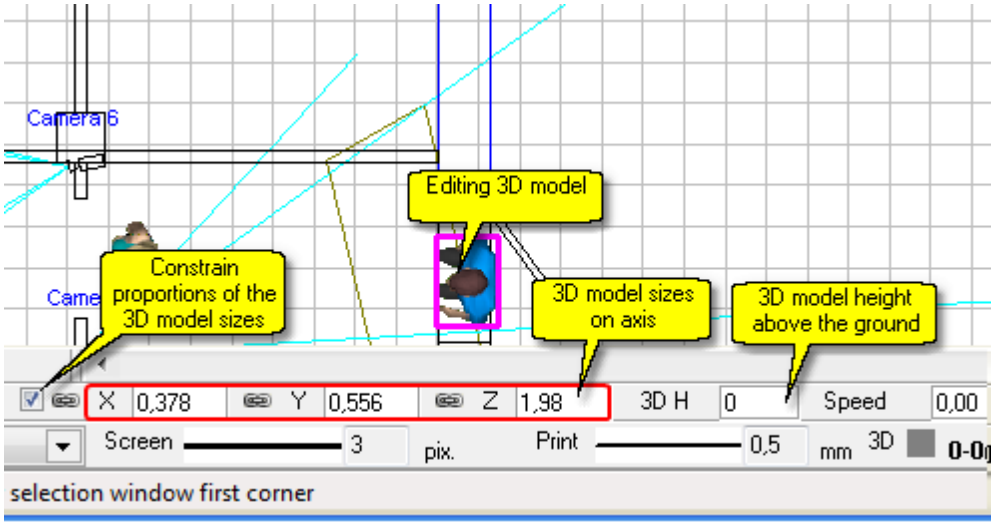


Fig. 9. Placing 3D models.

* *It is possible to copy, move and rotate 3D models like other constructions.*

On the **Current construction parameter panel** you can resize 3D models separately on axes.



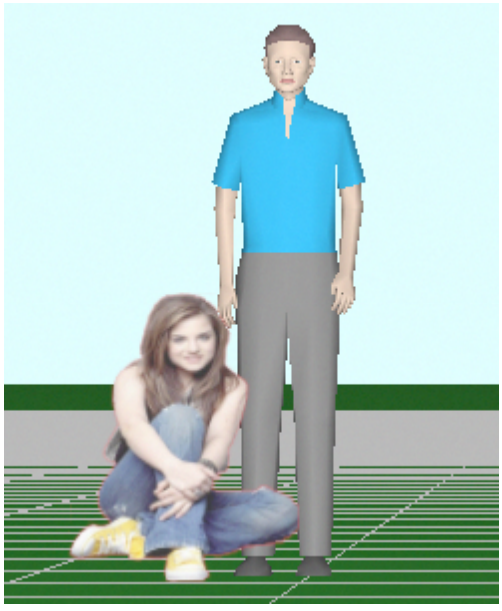
To do this, enter new values into X, Y, Z boxes during 3D model editing. If the box is marked, change of any size leads to proportional change of other sizes, thus model proportions are not broken. 3D model **height above the ground** is displayed and can be changed in **3D H** box.

* *More about ready 3D models see the Help system:* ***Interface> Graphics window>Menu bar>Menu items list>Constructions>3D model***

* *It is possible to import in VideoCAD 3D models and scenes from the* ***3ds max*** *software* http://cctvcad.com/Files/import_from_3dsmax.zip .

3D images

VideoCAD allows to place in the 3D space **raster images** in ***.bmp and *.jpg** formats.
In many cases the raster images can replace the **3D models** which are difficult to make. They can be used for modeling many objects from banknotes and plates up to a complex background.



To place **3D image** click on the **3D image** button on the **Tool bar**, then load **raster image file**, then specify minimum and maximum heights on the **Current construction parameter panel**, then place by clicking the **3D image** on the layout.

* *More about 3D images see the Help system:* ***Interface> Graphics window>Menu bar>Menu items list>Constructions>3D image***

Fig. 10. The girl is a 3D image.

Fig. 11. 3D model of the office has been created. The view in 3D window from Camera 4 lifted on 15m. height.

So, three-dimensional model of the office has been created (**Fig. 10**), and it has not taken a lot of time.
By activating different cameras, we can see the images from them in the **3D window** (**Fig. 11**). We can define what objects get in view areas, what objects shade others. On the base of this information we can correct positions and parameters of cameras.

* *For sequential activating cameras it is convenient to use keyboard shortcut **Ctrl+Spacebar**. Click on any place of the **Graphics window** beforehand to set input focus to it.*

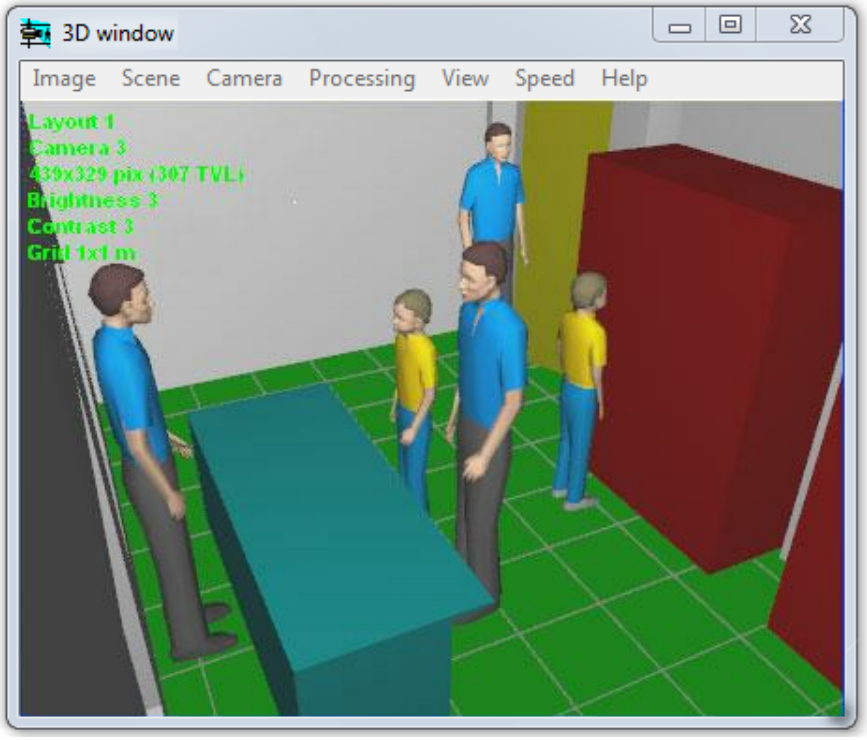


Fig. 12. The image from Camera 3.

Adjusting image quality according to equipment parameters

If we are interested, how detailed objects will look in the image, it is necessary for us to adjust parameters of the image. In fact, the images obtained at the previous stage, do not take into account parameters of equipment, therefore do not give information about how detailed this or that object will be recorded.

For example, a person's face, easily recognized on an image model, becomes a fuzzy spot on the real image (**Fig. 14**).

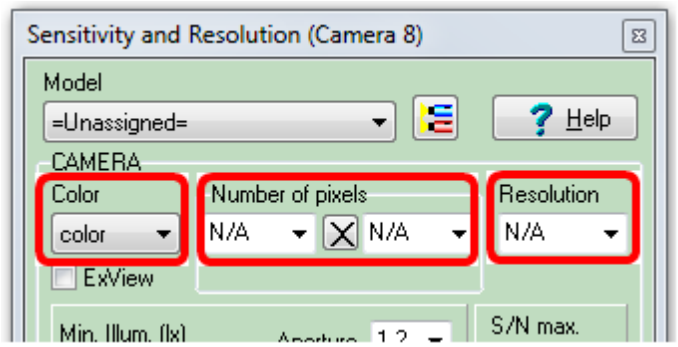
It is impossible to simulate image quality only by change of quantity of pixels, in CCTV there are specific distortions (for example: compression, capturing by interlaced fields, loss of contrast) which cannot be reduced to quantity of pixels only.

VideoCAD offers tools, which allow to simulate quality of camera image, which is very close to the real image. For precise modeling, it is recommended to use exemplary images kept from the previous installations of a similar set of equipment. Thus, all distortions of a path of videosignal are automatically taken into account. This technique is described in detail in the Help system: **Examples> Example 6 Determining person identification criteria by a real image.**
In the cases, which are not demanding special accuracy, it is enough to set parameters based on known parameters of used equipment.

For example, we have identical color cameras with **1/3" image sensor**, **752x582** effective pixels and an inexpensive DVR, which can capture video only **by interlaced fields** with **640x240** pixels. Output image size is **640x480** pixels. The DVR and communication lines introduce some loss of resolution. For keeping information in a certain period of time the middle compression is necessary.
Final horizontal resolution is **350 TV-lines**.

Adjusting camera parameters

Activate the adjusting camera, open the **Sensitivity and resolution** box, by clicking on the **Sensitivity and resolution** button on the **Tool bar**.



On the **Sensitivity and resolution** box, to the **Number of pixels** combo boxes enter the number of effective pixels of the **camera image sensor**.
Set **Color** and **Resolution** parameters.

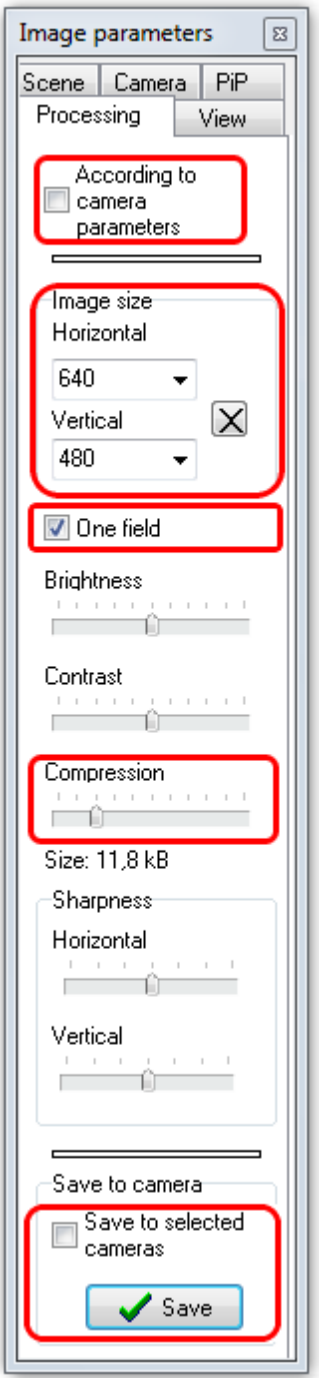
Other parameters in the box are concerned with camera sensitivity and illumination modeling. Leave without changes the other parameters.

Close the **Sensitivity and resolution** box and confirm changes.

* You can assign to cameras in the project camera models with set parameters. More about the camera models see the **Help system**: **Interface> Graphics window>Tool bar>Tools>View button group>Model of active camera**.

Adjusting image processing parameters

Open the **3D window** . Open the **Image parameter panel** by right-clicking on the **3D window**. On the **Image parameter panel** choose **Processing** tab.



On the Processing tab, in the **Image size** panel, specify the **number of pixels** of the output image.

Mark the **One field** box as video capturing is performed by interlaced fields. Leave without changes the **Brighness**,**Contrast** and **Sharpness** sliders. Move the **Compression** slider to position 3.

Click **Save** for saving the changed parameters.

If at clicking **Save** button the **Save to selected cameras** box was marked, processing parameter set on the **Processing** tab would be saved in all selected cameras.

After setting all processing parameters, mark the **According to camera parameters** box.
If this box is checked, processing parameters are set according to processing parameters of the active camera. As a result of activation of other camera, processing parameters will be changed according to processing parameters of this camera. Manual changing processing parameters will be disabled.

If this box is not checked, processing parameters could be specified manually. The set parameters will not be changed at activation of different cameras.

*During adjusting resolution, a **yellow and green frames** can appear on the image in the 3D window. These frames are displayed as a result of the **PiP** function when the **image size** in the 3D window is **less** than the **set number of pixels in the image**. **PiP function** will be described below in the **Modeling megapixel images** chapter. To disable the **PiP** function, switch to the **PiP** tab and check the **Off** box.*

Modeling an image according to equipment parameters

Open the **3D window**, by clicking the button on the **Toolbar** of the **Graphics window**. In the **Main menu** of the **3D window**, check the item **View> According to camera parameters**.
If this item is checked, 3D window size and visibility of additional elements are set according to parameters of active camera. As a result of activating other camera, 3D window size and visibility of additional elements will be changed according to parameters of this camera. Manual changing will be disabled.

If this item is not checked, 3D window size and the visibility could be specified manually. The set parameters will not be changed at activating different cameras.

It is possible to estimate the real resolution of the image model. For this purpose clear the item **3D window Main menu>View> According to camera parameters**, then check the item **3D window Main menu> View> Test chart**. The resolution can be determined by the point where the white and black diagonal lines are no longer distinct (fade to grey).
After determining resolution check the item **3D window Main menu>View> According to camera parameters** again.

** If the image in the **3D window** will be redrawn incorrect, for forced redrawing simply click on the image.*

For saving or printing the image, choose in the **Main menu>Image> Save as *.bmp (*.jpg, *.gif, *.tif, *.png)** or **> Print**.

By activating different cameras, you can obtain image models from them taking into account parameters of equipment.

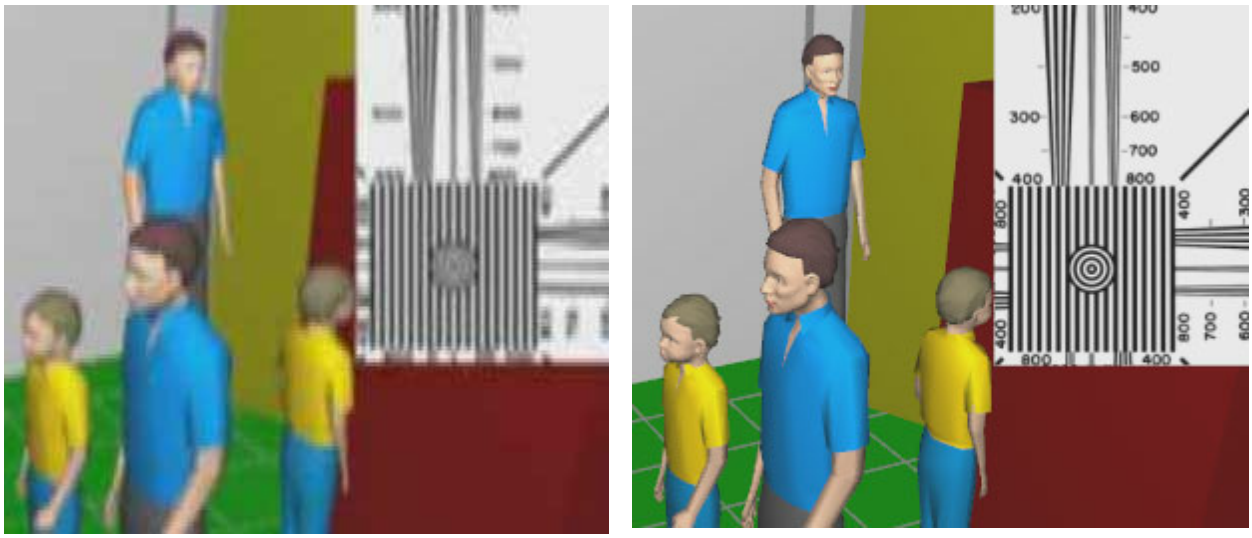


Fig. 13. At the left there is a fragment of image model in real scale taking into account real quality of recorded images. At the right there is the fragment of image model without taking into account real quality.

**** Pay attention, that it is not the entire image, but approximately a quarter of the image. Quality of the left fragment corresponds to a recording quality of a middling DVR, which capture video by interlaced fields at an middle compression, or an analog VTR with a multiplexer. The horizontal resolution is about 330 TV-lines.***

Modeling monitors

So, we have the modeled images from all cameras which our system will record. But, we are also interested in what and how detailed the operator will see on the monitor during live monitoring.
For getting this information, VideoCAD offers tools for modeling images on monitors in real scale.

Setting the monitor model

Click on the **Monitor window** button (**Fig.2**).

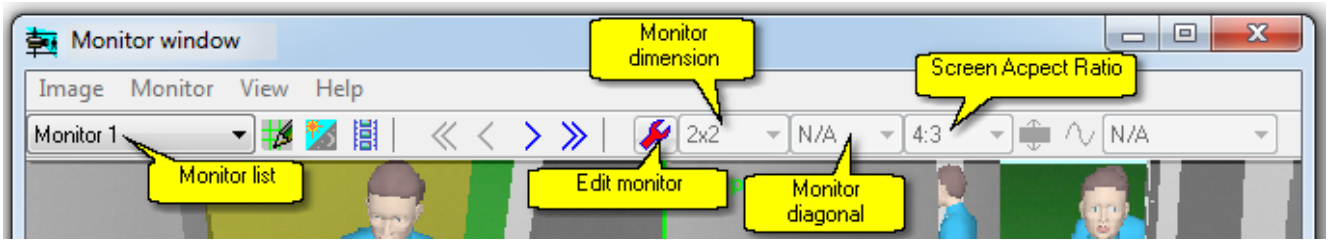


Fig. 14. Toolbar of the Monitor window.

In the appeared **Monitor window**, switch to the **Edit mode**, by clicking on the **Edit** button on the Toolbar (**Fig. 15**). The button should look pressed.

From the **Monitor dimension** combo box, choose "***2x2***" for simultaneous displaying images of the identical size from four cameras.
From the **Monitor diagonal** combo box choose the diagonal of the physical monitor, for example 9 inches.

* *If we leave "N/A" in the **Monitor diagonal** combo box, the size of the monitor will not be fixed, and we can change it by mouse.*

* *An image on the monitor is modeled in real scale. Therefore, if we choose the diagonal of the monitor, which is more than the diagonal of the real monitor, in front of which we work with the program, the monitor's model will be shown not completely, and scroll bars will appear.*

Connecting cameras to the monitor

As images from all our four cameras will be displayed on one monitor, select all cameras in the **Graphic window** by **selection window**.

* *For connecting all cameras on the layout to the monitor, it is possible to **select all** on the layout using keyboard shortcut **Ctrl+A**. Click on any place of the **Graphics window** beforehand to set input focus to it.*

Move cursor on the first (left top) cell of the **Monitor window** and click on it.

* *The cursor will look like this* .

As a result of these actions, the **3D window** will appear, in which images from all selected cameras will be automatically modeled. Then the received models of images will be placed on the monitor in real scale, starting from the cell you have just clicked (**Fig. 16**).

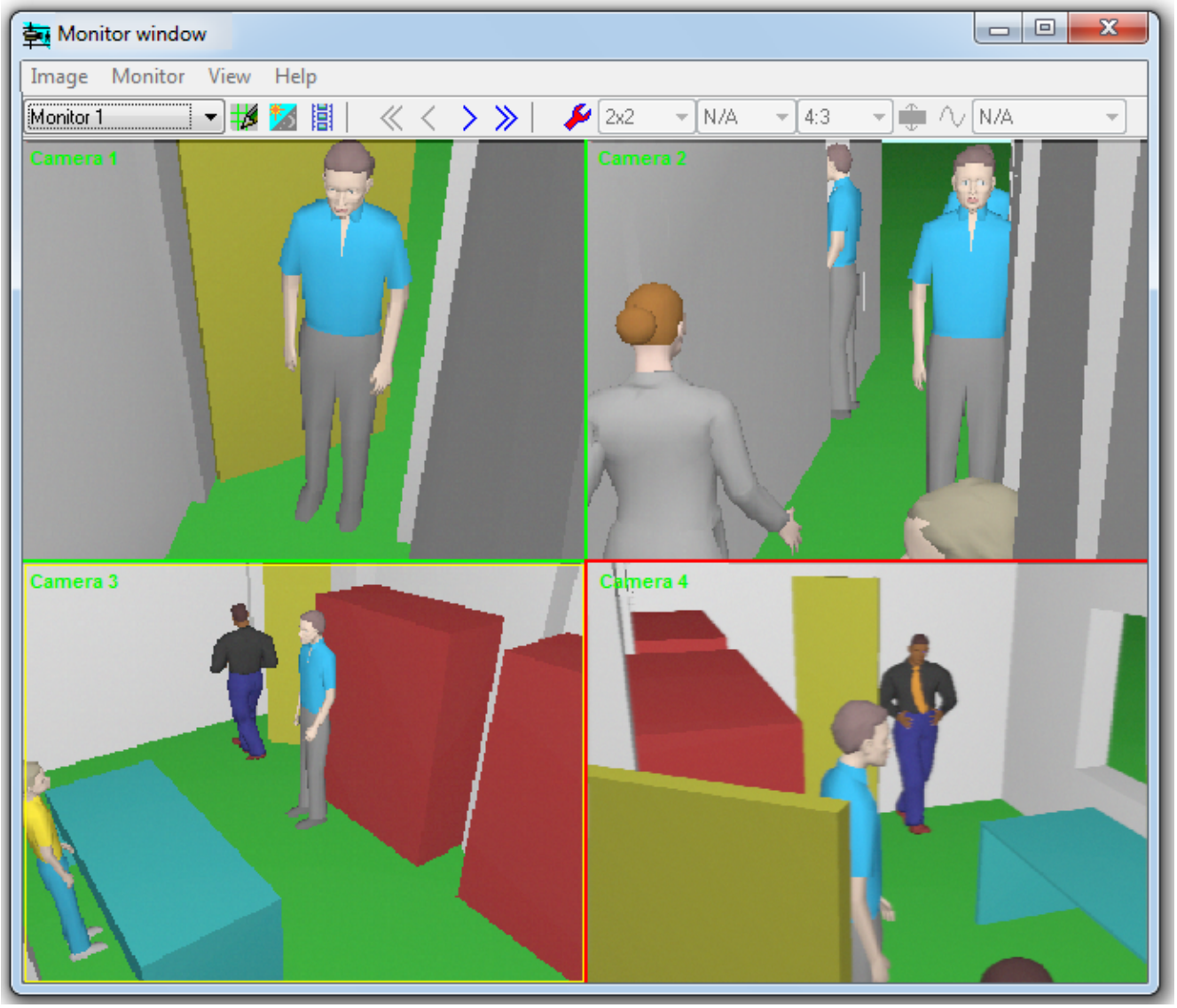


Fig. 15. The Monitor window with connected cameras.

* *The images in the Monitor window are modeled according to parameters of cameras and image processing, irrespective of the current setting of the 3D window. Then the obtained models of images are scaled to size of the monitor cells.*
For obtaining images taking into account parameters of cameras and image processing, it is necessary to set the parameters beforehand.
See above: Adjusting image quality according to equipment parameters.
After setting the monitor and connecting cameras, it is recommended to disable the **Edit mode**, by clicking on the **Edit** button once again. The button should look not pressed.

Additional features of the Monitor window

The **Monitor window** offers a lot of tools and flexible settings.
In one project, we can create up to 10 models of monitors, on each of which up to 100 images from cameras can be displayed.
Each monitor can have the separate physical size, separate set of cameras and parameters.
On the monitor, you can delete, move, replace, copy, swap images.
You can adjust monitors so that different images have the different size.
You can limit the monitor resolution if an analog monitor is modeled.
You can set monitor aspect ratio and switch on/off stretching images with different aspect ratio.
You can switch day time in the project and model images from the same camera for daytime and nighttime.

The Monitor window can display animated images and save them in the form of *.html file.
You can specify exact physical size and resolution of monitor.
Using pop-up menu invoked by a right click on the image, you can activate cameras, show **3D window** with the image from the camera, find cameras on the layout.

* *More about the **Monitor window**, see the Help system: **Interface> Monitor window**.*

So, we have obtained model of the image on the monitor watched by an operator during live monitoring (**Fig. 16**). For saving or printing the image, choose in the Main menu of the **Monitor window**: **Image> Save as *.bmp (*.jpg, *.gif, *.tif, *.png)** or **> Print.**

Adjusting the project on the basis of the image models.

Having analyzed the image model on the monitor, we can find out necessity of changes of the project. It is simple to make these changes:

1. Double-click on the image from camera, parameters of which should be changed. In result the **3D window** with the image from this camera will appear.

2. In the Main menu of the **3D window**, check **View>PTZH frame**. In result, the field of view in the 3D window will have been extended.
Real field of view will be limited by orange frame. On edges of the image, buttons will appear.

3. Using these buttons, it is possible to change camera positions and lens focal length similar to **PTZ camera**, and height of installation in addition. The current values of the parameters will be displayed near the buttons (**Fig. 17**).

* *These are the same parameters, which we can see in the **Camera geometry** box and about which we have read in the first part of the article.*

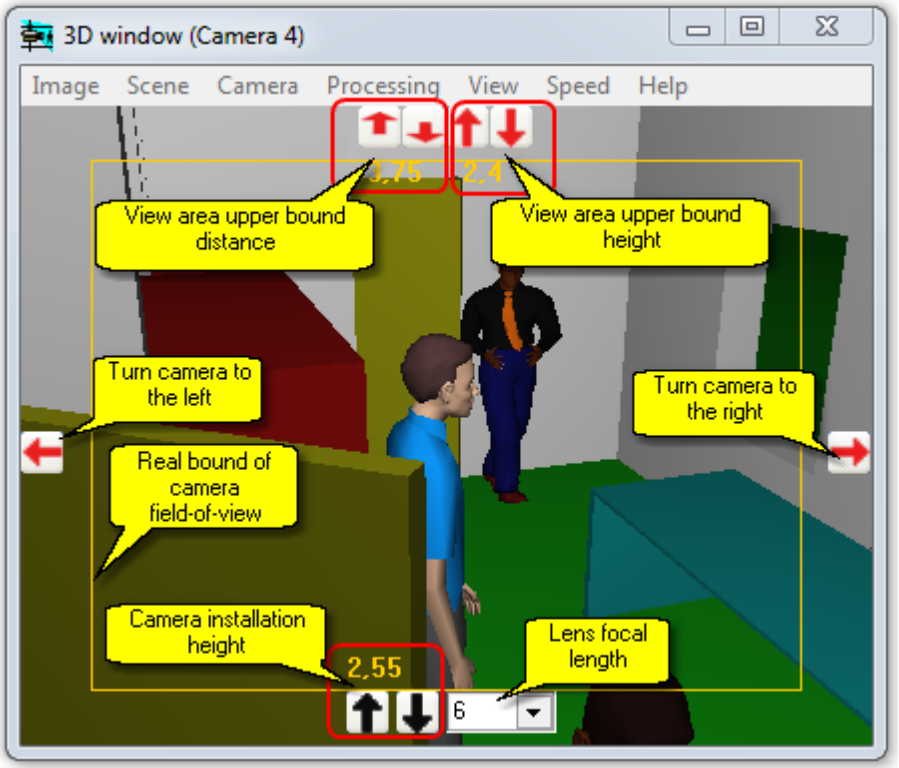


Fig. 16. PTZH frame in the 3D window.

4. Correct position of the camera, using these tools. At the same time, changes on the layout in the **Graphics window** will be made automatically.

5. In the PTZH frame mode you can pan and tilt the camera by moving the image like moving drawing in the Graphics window. Press left mouse button, move cursor with the button pressed then release the mouse button. Camera tilt angle is changed through changing **view area upper bound distance**. But when **Ctrl** is pressed, the tilt angle is changed through changing **view area upper bound height.**
You can also pan camera using **the arrow keys**.

6. For moving a camera on the layout, click by the right mouse button on the image in the **Monitor window**, then choose **Find on layouts** in the pop up menu. This camera will be selected and shown on the layout in the **Graphics window**. For moving, move the cursor precisely at the lens of the selected camera, then press the left

mouse button, then move the cursor on a new place and release the left mouse button.

* *You can also use the **Move** tool.*

7. After change of camera position, update the image from it on the monitor. For this purpose, right-click on the image from the changed camera in the **Monitor window** and choose **Update** from the pop up menu.

8. If necessary, it is possible to create new cameras, by copying existing ones, then connect them to the monitor. For connecting a new camera to the monitor, it is necessary to **Select** the camera on the layout, then enable the **Edit mode** by clicking on the **Edit** button , then click on the cell in which the image from this camera should be displayed.

9. If quantity of cells on the current monitor is not enough, it is possible to change quantity of simultaneously displayed images on the current monitor in the **Monitor dimension** combo box or to use an additional monitor, having chosen the new monitor in the **Monitors list** combo box (**Fig. 15**).

Modeling megapixel images

Because of the **Open GL** limitation, we can not create three-dimensional image with a resolution in pixels more than the **screen resolution in Windows**. However, modern megapixel cameras already have a much higher resolution.
Even when the camera resolution is less than the screen resolution, it is inconvenient to work with images that occupy a large area on the screen and require a lot of time for regeneration.

In most cases, we need only to see how an object on the scene will look on image from a camera with the specified resolution.
VideoCAD solves this problem with the help of **PiP** technology (Picture in Picture).

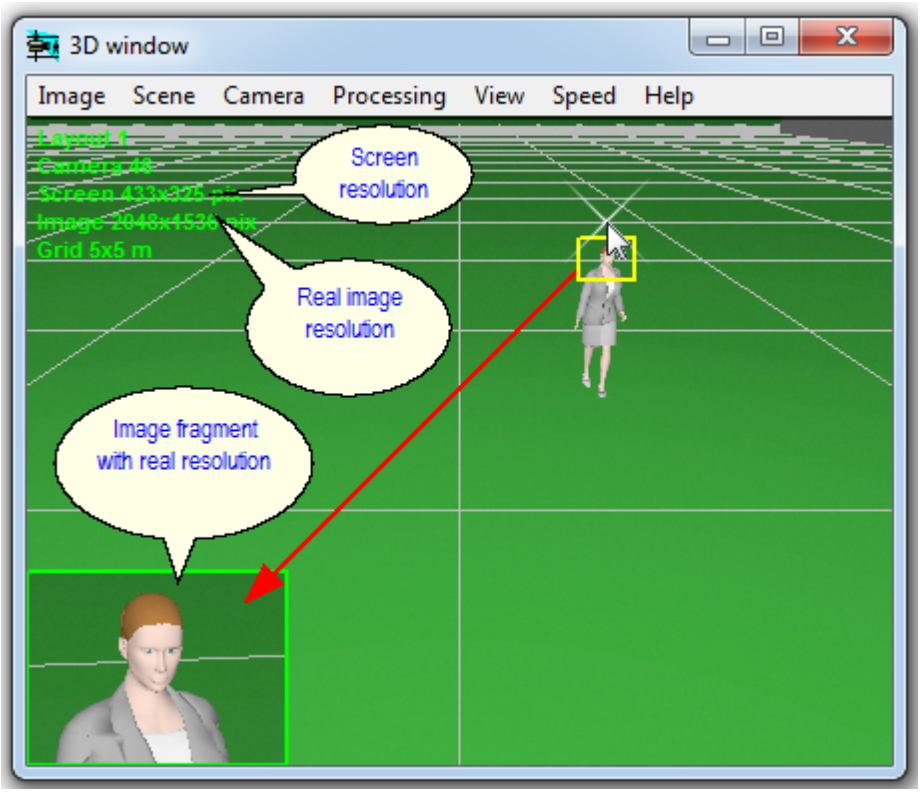


Fig. 17. Picture in picture.

By default the PiP mode will be turned ON automatically when resolution of image in the 3D window exceeds size of the 3D window in any dimension (in width or in height). In the 3D window a yellow rectangle will be displayed. And in the corner of the 3D window, inside a green rectangle, a image fragment from the yellow rectangle will be displayed.

You can quickly choose position of the yellow frame on the 3D **view** clicking by the **middle mouse button (or wheel**). If there is no middle button, you can enable control by the left mouse button.
Thus, clicking on the 3D image by the middle mouse button, we can see how the parts of the image, which we are interested in, will look in its original resolution.

The **PiP** mode offers flexible setting. You can specify which image will appear in the whole frame, but which in the small picture, you can adjust the position and size of the small picture, you can additionally magnify the fragment in the small picture.
To change **PiP** setting:

- By right click on the 3D window open the Image parameter panel.
- Chose PiP tab. Clear the According to camera parameters box if it is checked.

* *More about the PiP mode, see the Help system:* ***Interface> 3D window>Image parameter panel>PiP****.*

Shadows and Camera control area

Before reading this chapter, let's revert to the first article in this cycle: The principle of CCTV design in VideoCAD Part I. Camera view area.
In the definition of the view area in the first part it was mentioned that the object inside the view area will be visible on screen only if it is not shadowed by other objects on the scene.

Let's introduce a new definition:
Camera control area - a complex dimensional figure inside the view area.
Camera control area forms by subtracting shadows of environment objects (uncontrolled areas) from the camera view area.
Any object within the control area will be displayed on the screen.

VideoCAD can automatically calculate and display in the Graphics window (in 2D) horizontal projection of the control areas, ie areas controlled by cameras taking into account shadowing from obstacles in environment.

To enable calculation of shading is necessary:
1. Model objects in a 3D environment as described in this article.
2. Turn on shadow calculation with the help of the **Shadow** button on the Toolbar of the Graphics window (**see Figure 2**). To enable shadow calculation of the active camera you should select **Within projection** in the drop-down menu of this button.

After a while VideoCAD will calculate the projection of the camera control area, taking into account shadowing from obstacles in environment.

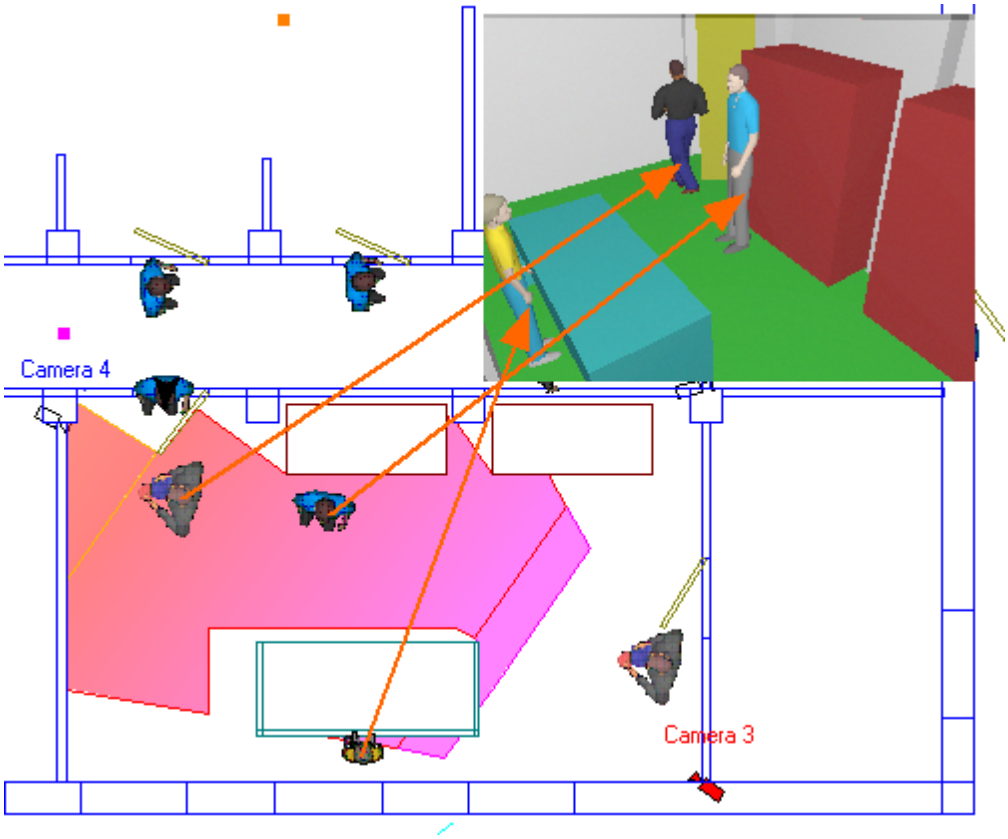


Fig. 18. Shadows.

The **Shadow button** works in conjunction with the **Spatial resolution** and the Fill projections buttons. Depending on the state of these buttons, shadows can be displayed in different ways: as filling, as shading, as a border lines, with mapping spatial resolution or not.

Shadows - a new powerful yet easy-to-use tool of VideoCAD 7. Shadows are calculated for all positions of cameras, shading objects can be located at any point of space. You should only enable calculation of shadows with the help of this button.

Shading is calculated according to a simple rule:

A point on the horizontal projection is considered visible if a vertical segment, formed by this point in the range of heights from the view area lower bound height to the view area upper bound height, is visible wholly.

The calculation of shading - resource-intensive operation. During the shadow calculation on the **Shadow button red frame flashes**.

The calculation of shading from 3D models is disabled by default to save resources. To enable the calculation of shading from the 3D models, check the Options box> Miscellaneous> Shadow>Calculate shadows for 3D models.
Additionally, for each 3D model, which must be taken into account when calculating the shading:

- double click on the model to switch it to editing state;
- on the appeared **Current construction parameter panel** check **Shadow** checkbox.

Whether or not a specific construction takes into account in the calculation of shading determines by the **Shadow** checkbox of the line **type used** for the construction.

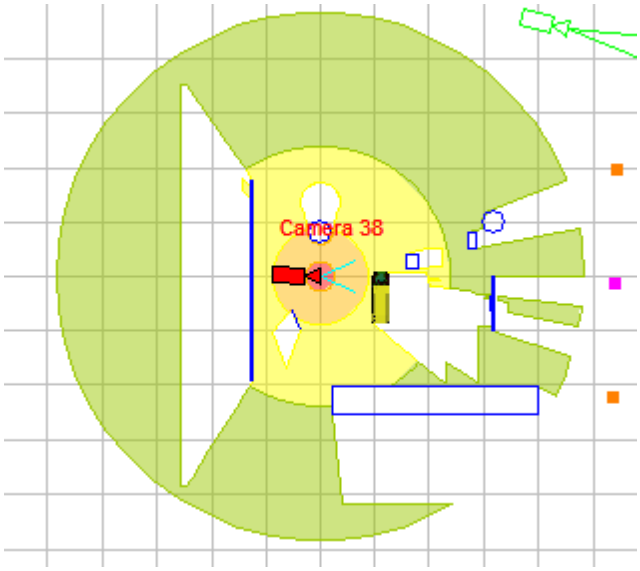
Drop-down menu of the Shadow button:

- **Within projection** - display view area projection taking into account shadows.
- **Dome** - display projection of the territory controlled by the camera in 360 degrees, without view area borders, but only taking into account the shadowing.

When the **Dome** item is chosen, actually the **control area** of a **dome (PTZ)** camera is displayed.

The **Dome** mode is also useful for choosing the best installation place for fixed cameras to make required areas reachable for the cameras.

In the **Dome** mode all shaded areas from the specified camera position become visible.



- **Off** - disable shadow calculation and displaying.

A button state at the moment of camera saving determines whether the shadows of the camera will be displayed when this camera is inactive.

If **selected cameras** exist on the layout, except the **Active camera**, this button changes view (and operates the visibility of shadows of all selected cameras simultaneously.

Conclusion

The use of three-dimensional modeling brings considerable advantages to CCTV system design.
VideoCAD offers the special tools intended for maximum exact CCTV system design with the minimum efforts.
Unlike other 3D editor software, VideoCAD provides means for modeling images taking into account real distortions in CCTV, megapixel images, animated images, shadows from obstacles and multi-screen monitors.
Thanks to these means three-dimensional modeling can be used not only for a choice of lenses and places of cameras, but also for a choice of qualitative parameters of all equipment, settings of system, and also in design of operator's workplace.
In this article step by step on a practical example the basic tools of three-dimensional modeling in VideoCAD 7.0 from creation of 3D model of environment up to creation of image models on monitors are described.
In addition, the convenient method for final project adjustment, modeling megapixel images using PiP, taking into account shading when calculating view area are described. Using the method described above, it is possible to design CCTV systems, which really meet all requirements.

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Part II. Person detection area, person identification area, license plate reading area. Spatial resolution.

Continue:

Part IV. Illumination and camera sensitivity in CCTV.
Part V. Video surveillance of moving objects.