

T-FLEX VR 17

USER MANUAL

3D MODELING IN A VIRTUAL 3D SPACE



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General information, system requirements

APPLICATION, ADDRESSED SOLUTIONS

T-FLEX VR can be applied at all stages of product development:

- Scheduling;
- Designing;
- Endorsing and accepting;
- Post-sales supporting;
- Training.

T-FLEX VR provides users with possibility to analyze product visually, check its ergonomics, assess design, as well as design it in virtual space. T-FLEX VR can also be used for training of operational personnel.

T-FLEX VR module is installed directly to the T-FLEX CAD system which allows to display opened 3D model in VR by clicking just one button. Moreover, 3D model does not require some special preparations – user sees in VR the same scene as in usual 3D window in the T-FLEX CAD. This allows to use T-FLEX VR together with T-FLEX Analysis and T-FLEX Dynamics.

CONFIGURATION

T-FLEX VR is supplied as additional dll-module connected to the T-FLEX CAD system as an application. More information about launching modules connected to the T-FLEX CAD, refer to the corresponding chapter of help for the T-FLEX CAD system.

T-FLEX VR is licensed as a separate product, therefore, application can be activated only in case user has active license for this module.

Apart from dll-module T-FLEX VR supply set has several additional files required for the module to operate.

Additional software – SteamVR program – can be required for the T-FLEX VR to work. In some cases, program is installed to the user's computer automatically in the course of preparation of hardware VR system. In other cases, user has to install this program himself/herself by downloading distribution kit at the following link: <https://store.steampowered.com/about/>

REQUIREMENTS TO THE HARDWARE VR SYSTEM

T-FLEX VR communicates with hardware VR systems via OpenVR software interface. This allows for the module to support work with wide range of VR systems introduced to the market, including HTC Vive and Oculus Rift. Prior to usage of other hardware VR systems, study their documentation to find out whether this hardware VR system is working via OpenVR interface.

Selected hardware VR system shall be equipped with VR controllers. Without VR controllers it is impossible for user to interact with T-FLEX VR.

SYSTEM REQUIREMENTS FOR USAGE OF T-FLEX VR

Minimum requirements for hardware in order to work with T-FLEX VR correspond to minimum requirements set by modern hardware VR systems:

Processor:	Intel i5-4590 / AMD FX 8350 or better
Graphics:	NVIDIA GeForce GTX 1060 / AMD Radeon RX 480 or better
Memory:	no less than 4GB

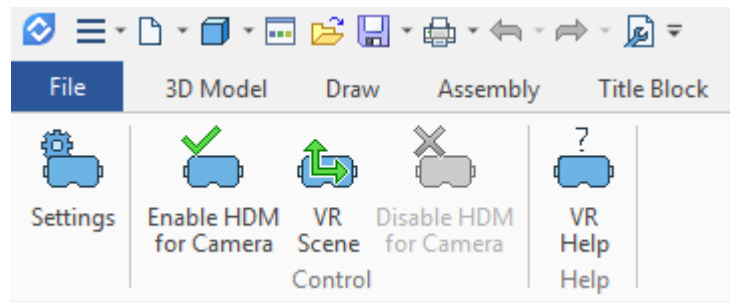
Video output:	HDMI, DisplayPort 1.2, or better
USB port:	1 to 3 (depending on equipment) USB 3.0 ports or of higher speed
Operating System:	Windows 8.1 or later, or Windows 10

However, for more convenient work it is **recommended to use:**

Processor:	Intel i7 or better
Graphics:	NVIDIA GeForce GTX 1080 or better
Memory:	no less than 16ГБ
Storage:	SSD
Operating System:	Windows 10 for x64 processors

System general principles

T-FLEX CAD models do not require specific preparation to display them in VR.

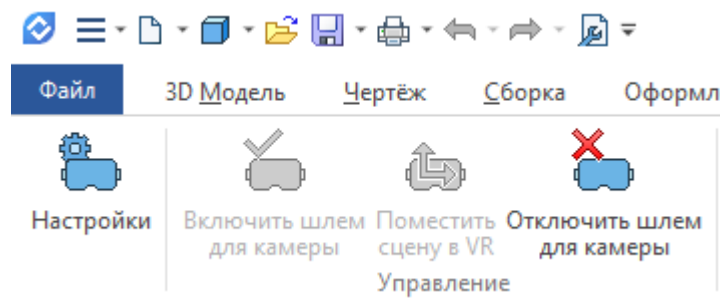


To display opened 3D model in VR

- make sure that VR controllers and other components of hardware VR system are turned on and functioning;
- switch to VR tab;
- click on the “Enable HDM for Camera” or “VR Scene” button in the toolbar;
- in the dropdown list select camera to be activated. If the scene has no cameras, the system offers to create a new one.

After all abovementioned is done, user can put the headset on and start interacting with 3D model in the virtual space.

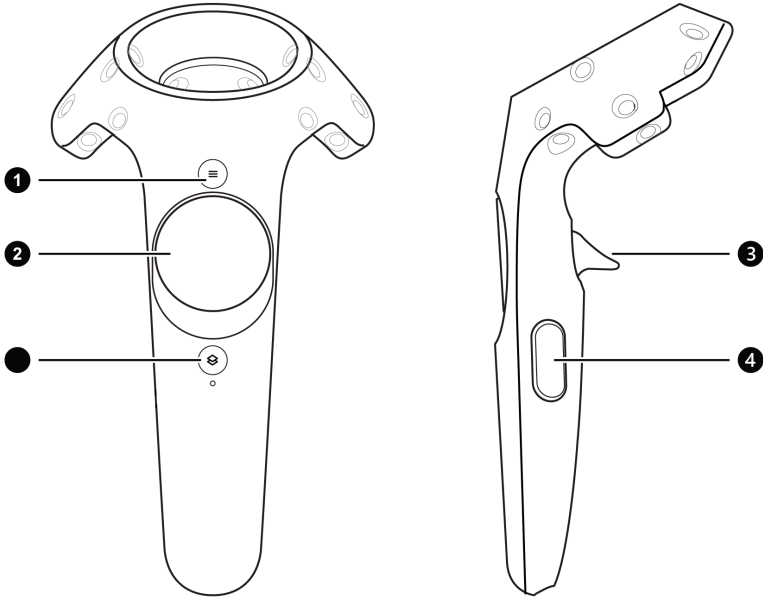
Display style of VR scene corresponds to the style set in the active 3D window at the moment VR mode is switched on. To edit display style in VR, turn VR mode off, edit image parameters in 3D window and turn VR mode on again. This note is also applicable to the background image in the VR scene.



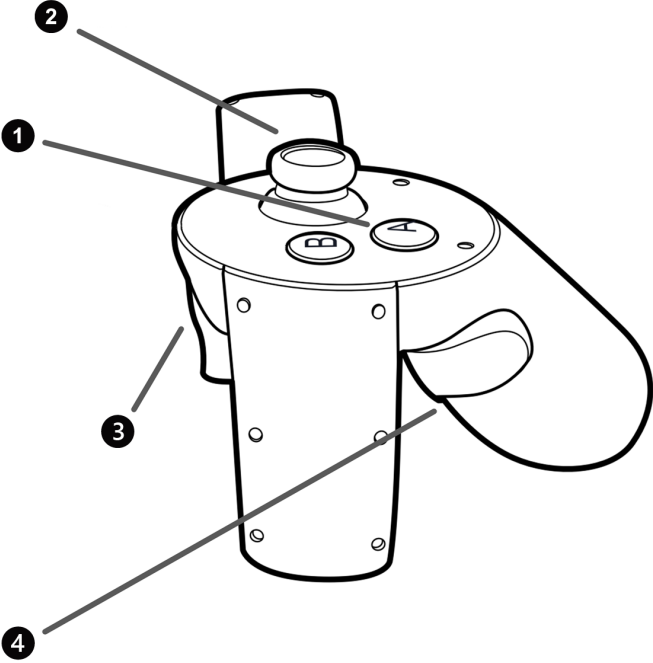
To finish working in VR mode click on the “Disable HDM for Camera” in the VR tab of the list of T-FLEX CAD options or select “Exit” option in the VR menu.

VR Controller button mapping

Depending on type of hardware VR system, configuration of control components on VR controllers may be different. Below layouts of VR controllers for HTC Vive and Oculus Rift are presented.



Buttons mapping for VR controller of HTC Vive system



Buttons mapping for VR controller of Oculus Rift system

Numbers from 1 to 4 designate following components:

- 1 – Button to open VR menu
- 2 – Touch panel or stick
- 3 – Trigger
- 4 – Side button

T-FLEX VR modes and commands

Basic commands to navigate within VR- scene

Navigation, Rotation, Scaling and Flight are navigational commands available to users at any time regardless of active command mode selected in VR menu.

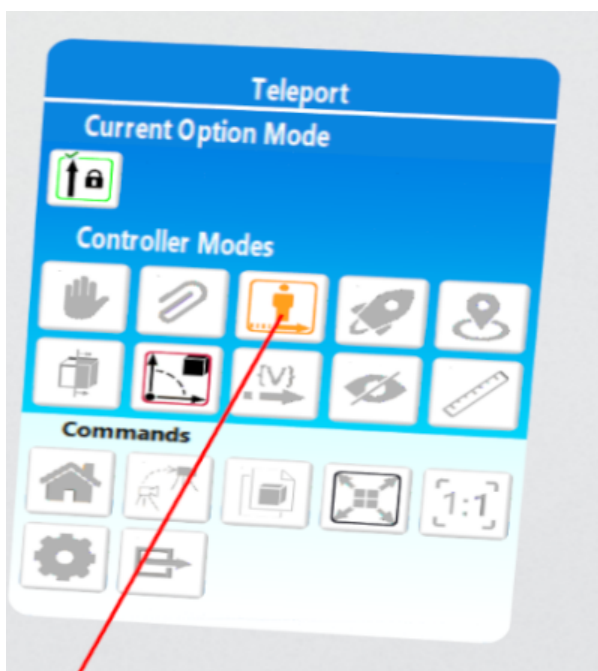
- **Navigation.** To move the scene, keep the Side button pressed on the VR controller (required controller is indicated in the T-FLEX VR module settings). When controller is moved, VR scene moves in the same manner.
- **Rotation.** To rotate the scene, keep side button pressed at both of the VR controllers simultaneously. When controllers move in space, rotation is performed about the point in the space located between two controllers.
- **Scaling.** To edit scene scale, hold side buttons on both VR controllers. When controllers move (depending on distance between them), the scale of the scene changes.
- **Flight.** To move (fly) within the scene, use Sticks or Touch panels on one or both VR controllers. When Stick is moved in the selected direction, user starts to move in that direction with set speed. Speed is set by Stick inclination degree, as well as by VR controller settings (see below).

By default, Rotation and Scaling commands are performed simultaneously. However, one or both commands can be turned off in the VR settings.

Other commands available for T-FLEX VR must be selected in the VR menu.

VR Menu

VR menu allows user to select modes, commands and set various options within virtual space. VR menu is opened via corresponding button on VR controller. VR menu appears in the part of space to which VR controller is pointing. VR menu disappears automatically as a command is selected or when directive beam goes beyond menu frame.



Organization of VR menu

VR menu is organized in the following manner:

- Upper part of the menu displays current mode of VR controller.
- A list of additional options for current mode or command of VR controller is shown below.
- Next the list of modes available for VR controller is disposed.
- Bottom part displays the commands available for selection in the VR menu.

Both modes and commands allow to change the virtual space or set the representation options. There is always one active mode at any moment of work (Take mode is active by default). User defines the necessity of command running. Two different modes cannot be activated simultaneously. Any command is available when any mode is active. Two different commands cannot be run simultaneously (excluding base commands that are always available).

Switching between command signals algorithm within VR menu

To change the mode it takes to:

- activate VR menu by clicking "Menu" button on VR controller;
- point at the mode with beam emitted from VR controller;
- select the mode by clicking on Trigger of VR controller;
- specify the options (if they are available and necessary);
- click "Trigger" button to perform the action corresponding to the mode.

After the action is performed at any mode (e.g., if firstly user Took the object and then released it), the action is completed. To re-activate the action in selected mode just click on "Trigger" button.


To run the command it takes to:

- activate VR menu by clicking "Menu" button on VR controller;
- point at the command with beam emitted from VR controller;
- select the command by clicking on Trigger of VR controller;
- specify the options (if they are available and necessary).

Click "Trigger" button to activate the command. After performance of the command it is completed. Use VR menu to re-run the command.

The current mode of VR controller and the command that will be activated via Trigger are displayed as text on VR controller.

Modes

 **Pick Up.** The mode allows to "take in hand" an object of the scene. Once mode is activated, point at 3D object of the scene with the beam and hold the Trigger button on VR controller. The selected object starts to move towards 3D controller and will be moving until it is in the "hand" of the user. The selected object can be examined closely by moving the controller. Moreover, the selected object can be rotated or scaled with side button of the second 3D controller. Any part of the model or 3D body can be operated as object. Object returns to its initial position when user stops holding Trigger.

The options of the mode:

- **Fragments as Single Bodies.** When enabled, user will take separate bodies of the model. When disabled – all model at once.
- **Fixation.** When enabled, the bodies of the model will keep their position after the body is released. When disabled - the bodies will get back to their initial position.
- **Restore Objects Position.** Brings all bodies to initial positions.



Mates. The mode allows to move model components according to set mates. To move mating components in the VR scene, point at targeted 3D object of the scene with the beam and hold Trigger on VR controller. From this moment all movements of VR controller affect the selected object. All objects return to their initial positions as soon as the Trigger is released. The mode has two options defining movement character:

- **By Mates;**
- **By Manipulators.**



Move to object. In this mode, the user points to the part of the 3D-model, which he wants to see closer, and "teleports" so as to examine it comfortably. This mode can be useful when you need to visually evaluate industrial 3D models with a large number of small parts located at some distance from each other. Depending on controller settings (see description below), user might need to click or to click and hold Trigger.



Flight. In this mode user points to a point in the 3D model and then moves towards it with set speed as long as he/she holds Trigger of VR controller. User just needs to hold the Trigger to move in the selected direction. This mode is convenient to move smoothly along the VR scene.



Teleportation to floor. In this mode user "teleports" to a new position as if his/her legs are standing on the selected point. This mode is the most convenient for architectural models when user wants to "walk" inside virtual objects. Depending on controller settings (see description below), user might need not only to click but also to hold Trigger.



Section. Cutting plane appears in the scene. The plane can be dynamically moved or placed in the required position. After mode activation, hold Trigger on VR controller. Active cutting plane appears in the scene and moves in compliance with movements of the 3D controller. Cutting plane holds fixed position (stops moving) as soon as user stops holding the Trigger. To hide cutting plane which was created earlier, user can select a special option located in the upper part of VR menu or click Trigger and Side buttons of the VR controller simultaneously.


Number of sections which can be applied to the VR scene is set in the settings of VR module. It is important to know that each additional section slows down the rendering of VR scene. Therefore, it is not recommended to use more than one section at a time.




Transformation. The mode allows to set the transformations of the whole VR scene as if it is in the user's hand. After mode activation point the beam in the certain direction and hold Trigger on VR controller. The whole VR scene starts moving according to movements of the VR controller. As soon as user releases Trigger VR scene stays at a new position. The mode has a **Vertical Stabilization** option. When enabled, the scene moves only in the horizontal plane. The constraints for the allowable movements can be also set in **Navigation Settings** command (described below).

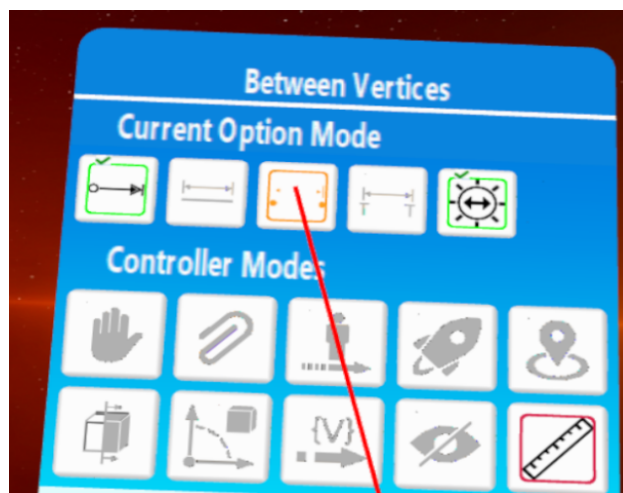


Work with Manipulators. In case there are 3D manipulators in the scene linked to the external variables of the model, these 3D manipulators can be used in the virtual space to change model configuration. To change VR controllers, activate the mode via VR menu. After mode activation all 3D controllers presented in the scene will become visible.

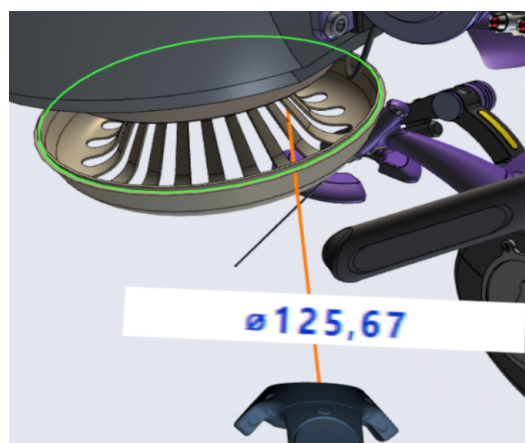
 **Show/Hide.** This mode allows to completely hide components or to make them transparent in the VR scene by pointing at them with VR controllers. After activation the set of additional options appears at the upper part of the VR menu :

- **Show all objects.** Allows to show all hidden bodies.
- **Transparency of Hidden Objects.** Switches invisible and transparent modes for the pre-selected bodies.
- **Hide Construction Elements.** When enabled, construction elements are hidden.
- **Continuous Mode.** When enabled, the beam of controller is always active, so several bodies can be selected in series.

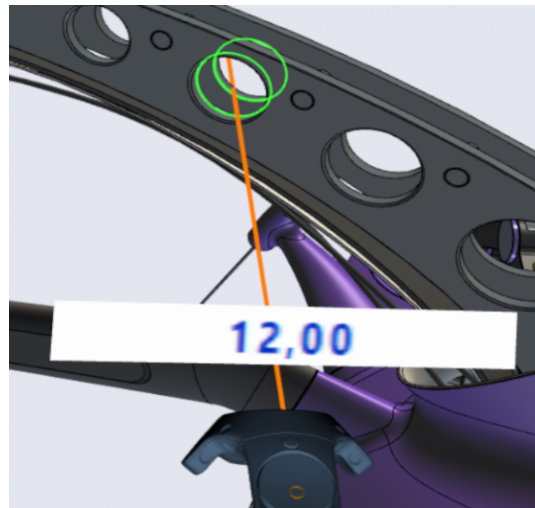
 **Measurement.** Four measurement variants and dynamic highlighting option (active by default) are available.



- **Distance.** The distance from the ray origin point to the scene point of ray incidence.
- **Elements.** If a straight edge is selected, the length of the edge is measured; if the arc of a circle is selected, the diameter of the circle is measured.



- **Between Vertices.** The distance between two vertices selected on the objects.
- **Between Elements.** The option measures the minimal distance between two selected elements. The edges and vertices can be selected.



- **Dynamic Highlighting.** The option highlights the elements pointed by the ray.

Commands



Home. This command allows to put active VR camera to the initial position and set scene scale to 1:1.



Select Camera. The command allows to quickly switch between several cameras preset by the user in the scene. The switching is performed in the pop-up window containing the list of available cameras. This can be useful when user needs to switch quickly between preset viewpoints.



Switch Document. If few documents are opened the command allows to switch between them. The command has three options.

- **Previous Document.** Перейти в документ, закладка которого слева от текущего. Switch to document the bookmark of which is on the left of the current one.
 - **Next Document.** Перейти в документ, закладка которого справа от текущего. Switch to document the bookmark of which is on the right of the current one.
- Select Document. Появляется окно с перечнем открытых документов. The window with the list of opened documents appears.



Scenario. The command allows to launch selected animation scenario and observe it from any angle. Animation (firstly in the forward direction and after reactivation in reverse one) starts automatically after the corresponding option in the VR menu is selected.



Real Scale. This command sets scene scale in full correspondence with real scale.

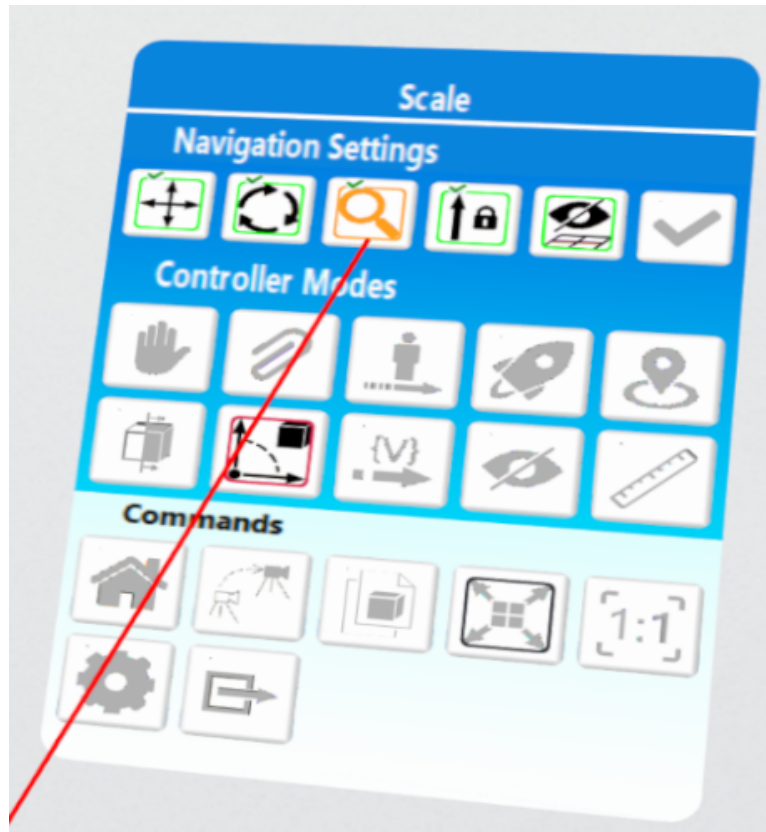


Navigation Settings. Команда даёт доступ к самым часто используемым настройкам без выхода из режима VR. Настройки определяют поведение контроллеров в базовых командах описанных выше. Настройки состоят из нижеследующих опций. The command allows to make high-usage settings without closing VR mode. The settings define the behavior of controllers in base commands described above. The settings contain the following options.

- **Move.** When enabled, VR controllers move the scene (active by default).
- **Rotate.** When enabled, VR controllers rotate the scene (active by default).
- **Scale.** When enabled, VR controllers scale the scene (active by default).
- **Vertical Stabilization.** When enabled, the vertical do not change its position during scene rotation. Regardless the manipulations, the model rotates only about vertical axis. The disabling of this

option during the work with large (e.g., architectural) models is not recommended, because it may arouse the discomfort (so called Motion Sickness effect).

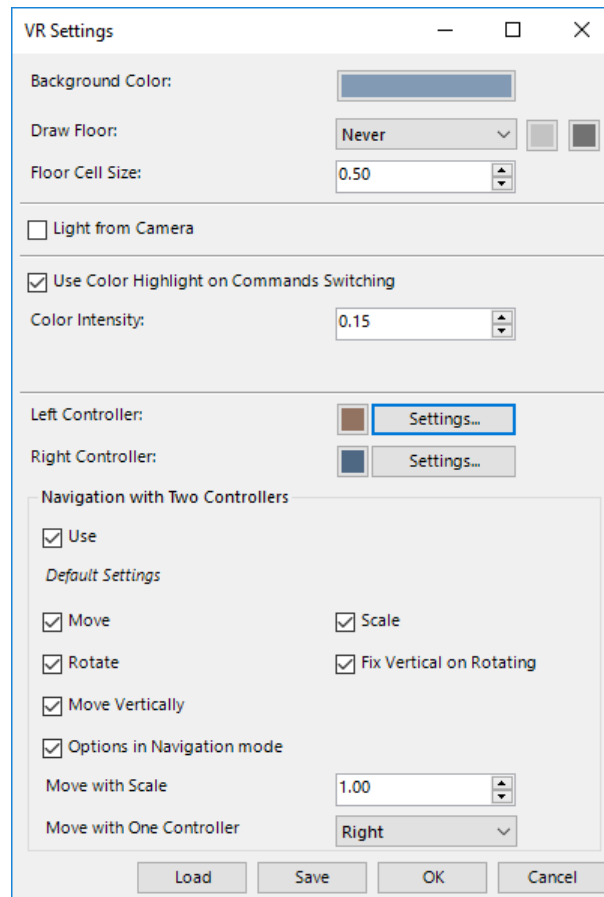
- **Draw Floor.** Click on the icon representing this option causes the consistent switching of floor representation conditions in VR scene. 3 variants are available: hide, show when moving, show always. The presence of floor in the scene reduces the possibility of discomfort induction (Motion Sickness effect), related to orientation loss in the virtual space.
- **Accept.** Accept specified settings.



- ➡ **Quit.** Command is used to disconnect hardware VR system from the T-FLEX CAD system.

T-FLEX VR Settings

T-FLEX VR module, in compliance with T-FLEX CAD policy, was initially developed to be as flexible as possible, configurable for wide range of tasks. Therefore, users have access to countless parameters allowing to set up operation of T-FLEX VR in general and its components in particular.



Access to the VR parameters menu is gained via selection of corresponding option in the VR tab.

Settings window sets up VR settings for the whole T-FLEX CAD application regardless of the document opened at the moment.

Configurations of settings can be quickly saved and loaded with the help of buttons in the bottom part of the window – this can be useful for quick configuration of VR system in compliance with user's preferences.

Options

Background color. Background color in the VR scene in case texture of the surroundings was not set in the parameters of the 3D window.

Draw floor. In the dropdown list user can select floor display conditions for the VR scene (see description of Draw floor option). Two color buttons to the right from the dropdown list allow to set color of the floor.

Floor Cell Size. Floor Cell Size. Set in meters.

Light from Camera. If the flag is enabled, light sources are displayed in the scene: they are moving with the camera. Disable this function, if you created light sources for the 3D scene manually.

Use coloring Highlight on Command Switching. If this option is enabled, selection of options in the VR menu is accompanied with short-period change of color of the VR scene surrounding the user.

Color intensity. Intensity of color change during change of VR command signals.

Left controller/right controller. Color button – intended to set color for left/right VR controller
 “Setup...” button – additional dialog box to set up parameters of VR controllers (description of dialog box and its options – see below).

Section «Navigation with two controllers»

Move. When enabled, VR controllers allow to move the scene.

Scale. When enabled, VR controllers allow to scale the scene up/down.

Rotation. When enabled, VR controllers allow to rotate the scene.

Fix vertical line during rotation. When enabled, vertical line does not change its position during rotation (see description of “Fix vertical line” option in the VR menu). I.e. regardless of manipulations, the model rotates only against the vertical line. It is not recommended to disable this option when working with large (e.g. architectural) models, as this can lead to discomfort (so called Motion Sickness effect).

Movement along vertical line. When enabled, movement will take place only in the horizontal plane. This might be essential in case movement is required only in the floor plane.

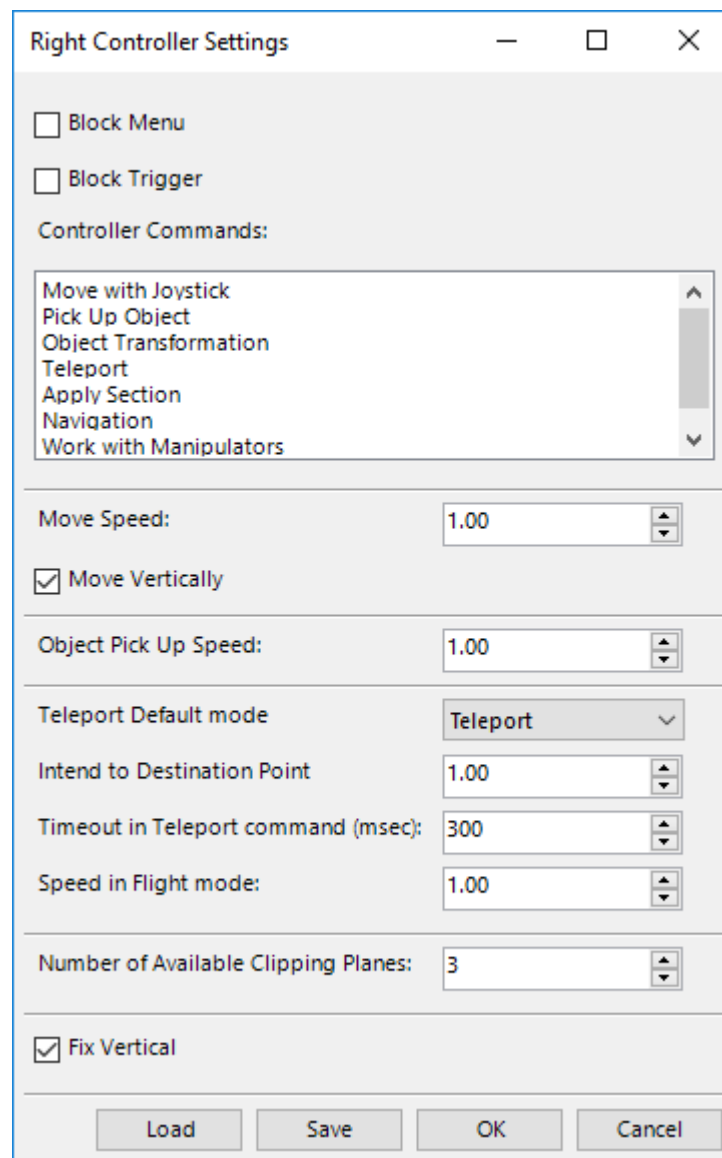
Options in the navigation mode. When enabled, user has quick access to navigation options when he/she clicks side button of the left controller.

Scale during navigation. Scale setting during scene navigation with one VR controller (and side button held). Scaling up may be convenient when user needs to examine the model in the 1:1 scale on the one hand, and on the other hand it takes to many efforts and time to move along the model due to its size.

Navigation with one controller. With the help of the dropdown list user can select which VR controller is used to move along the scene via side button.

VR controllers settings

Each of the two VR controllers can be set up separately (by clicking “Setup” button to right of the captions “Left controller” and “Right controller”) by selecting set of command signals user prefers to have in the left or right hand.



Block menu. Option allows to disable menu for the controller completely.

Block trigger. Option allows to disable Trigger of the controller.

Controller commands. The list allows to disable availability of certain command signals for the controller. To make one of the command signals unavailable, double-click on it. Unavailable command signals are marked red in the list.

Speed. Coefficient sets flight speed in case Stick or Touch pad are used.

Movement along vertical line. This option allows to enable/disable possibility to move along vertical line (during flight) for the controller. Option can be useful for navigation inside architectural objects where user needs to move only within floor plane.

Object attraction speed for "Take" command. This coefficient sets attraction speed of an object to the controller in case "Take" command is activated.

Initial mode for "Teleportation" command. Teleportation command can operate in two modes – just "Teleportation" (instant transfer to the point) or "Flight" (movement to the point in set period of time). This option allows to select the mode for the VR controller.

Setback distance till destination point. Distance (meters, against real physical size) of setback till selected point in the "Teleportation" command.

Delay for "Teleportation" command. Time period (set in milliseconds) from the moment Trigger is pressed till "Teleportation" command is activated.

Speed in the Flight mode. This coefficient sets speed for the "Flight" command.

Permissible number of cutting planes. Parameter sets maximum number of simultaneously displayed cutting planes for the "Section" command.

Vertical line fixing. Option allows to enable/disable fixing of the vertical line for the "Transformation" command.

Appendix 1. Options for organization of user's workplace

At this moment, depending on applicable VR system, there are two options how to organize user's workplace:

- Limited space;
- Room-scale space.

Limited space: for this option workplace where user can move in the VR headset is of little space, approximately 1.5 x 1.5 meters. User can work both in sitting and standing position. In this case it is preferable for user to be oriented towards detectors of the VR system. This workplace option suits best for 3D models of small size (in reality). Hardware VR systems of Oculus Rift type can be used for working in such conditions.

Room-scale: for this option workplace is of bigger space and user can move freely in space. For the purposes, at the moment, VR system of HTC Vive type suits best as it allows to set working area with space up to 4.5 x 4.5 meters. This workplace option suites best for 3D models of big size (in reality) – architectural projects, vehicles.

Appendix 2. Terms, definitions and abbreviations

T-FLEX CAD – computer-aided design system intended for creation of 3D models, drawings of parts and assemblies, as well as for drafting of design documentation.

T-FLEX VR – program module allowing to use hardware VR system together with T-FLEX CAD system.

VR – virtual reality, world created via technical means which is transferred to a person via his/her feelings: sight, hearing, touch, etc.

Hardware VR system – hardware system containing unit put on the head with one or several displays to which images for left and right eye are provided, system of lenses to correct image geometry, VR-controllers, as well as tracking system which monitors unit orientation in space.

VR-controller – input unit intended for user to interact with program within virtual space.

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