SMART CONSTRUCTION

Smart Construction Simulation

Quick Guide

2024.4
Ver1.0-0007

Before you read the Quick Guide:

■ Before you start

- This Quick Guide explains the procedures for using Smart Construction Simulation.
- For units of measurement, the International System of Units (SI) is used. Explanation, numeral values, illustration, etc. are based on the information as of the time the Quick Guide was prepared.
- If you have any questions or opinions, please contact Smart Construction Support Center.
- Use the application after understanding the contract conditions, guarantees, and responsibilities stated in the application software terms of service.
- Screen and display of the application may change when updated. If there are any differences between what is written in this guide and the display on the application screen, operate according to the application display.

■ Trademark used in Quick Guide

- Smart Construction are trademarks or registered trademarks of Komatsu Ltd.

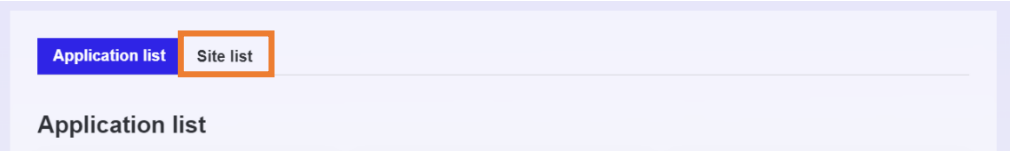
*In general, company names, product names, etc. written here are business names, trademarks or registered trademarks of each company.

Preparing to create a new

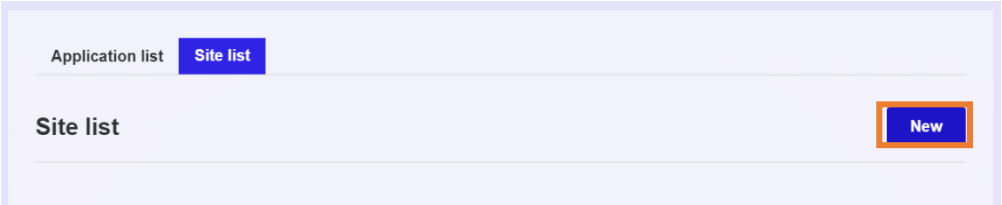
1.1.1 Creating a new jobsite (Jobsite Setting)

You cannot create a new jobsite directly from Smart Construction Simulation.
When creating a new jobsite, you need to create a new jobsite from Smart Construction Portal jobsite list (registration of necessary information).

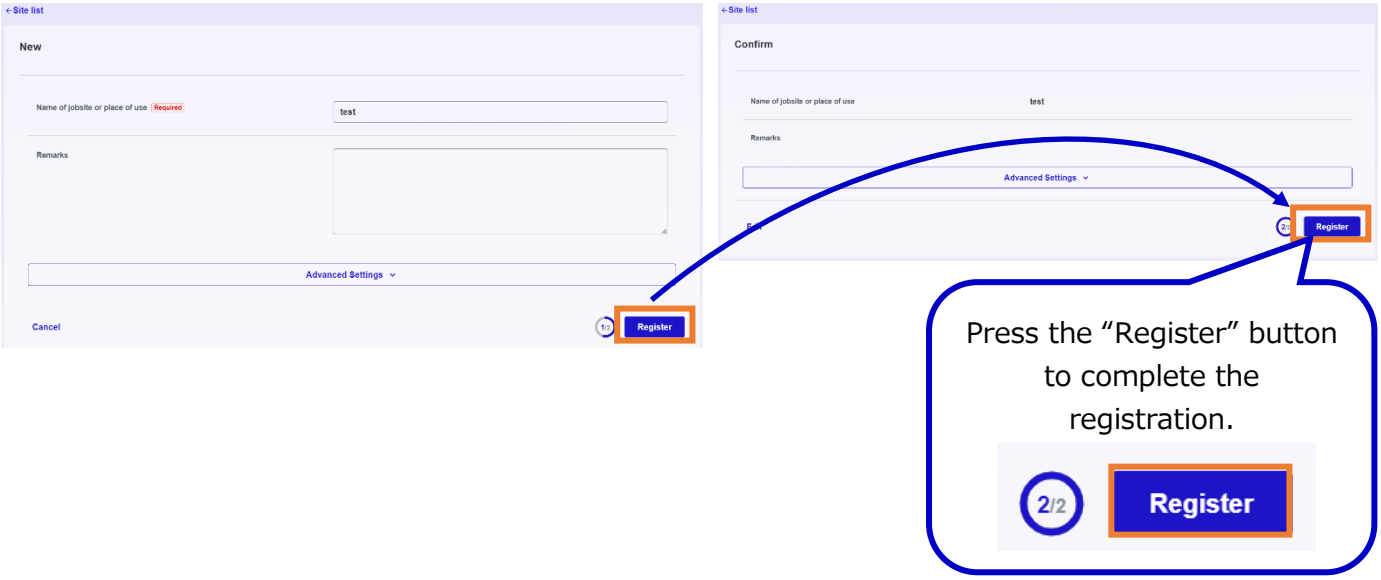
1. Log in Customer Portal before entering the “Site list”.



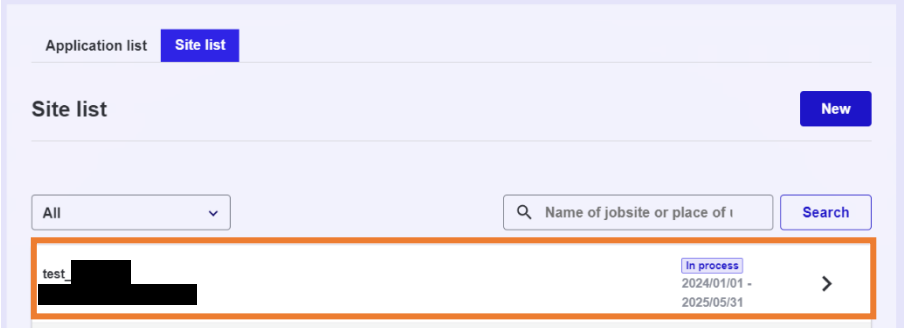
2. Press the "New" button.



3. Fill out the form completely, press the 1/2 “Register” button on the bottom, and press the 2/2 “Register” button on the confirmation screen.



4. The new site is registered in the "Site list".



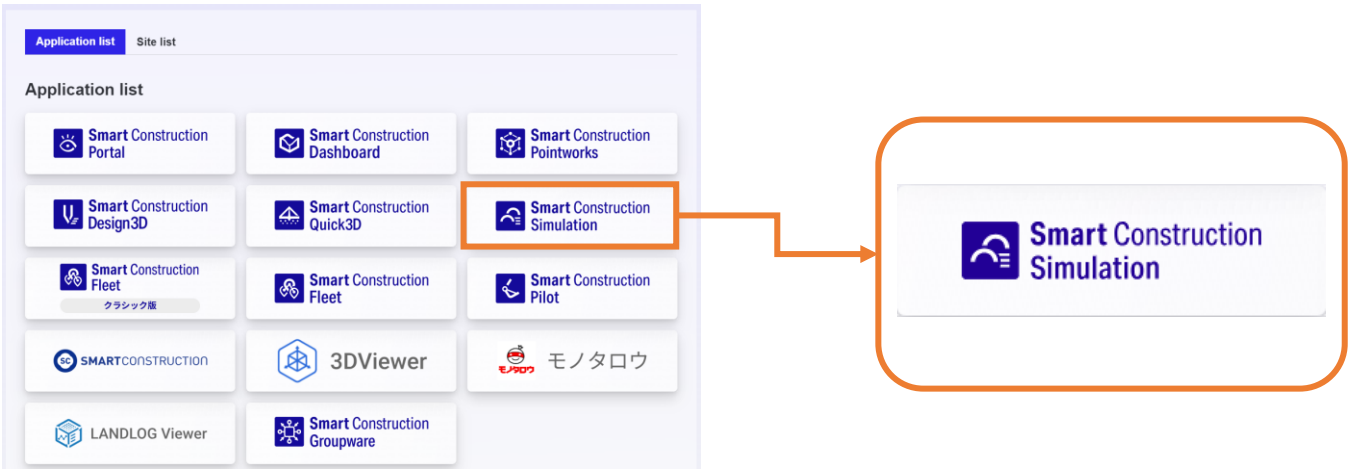
1.1.2 Converting a jobsite into a project with Smart Construction Simulation

Convert a jobsite created in the “Jobsite Setting” into a project in Smart Construction Simulation.

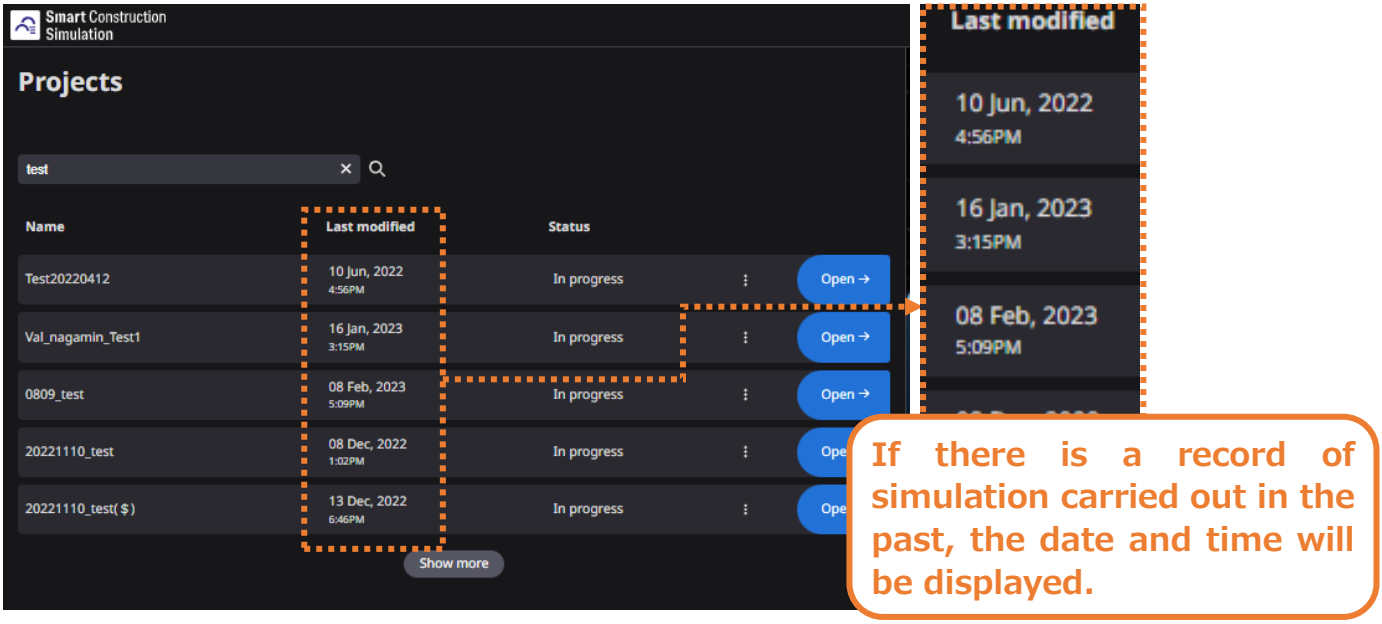
Supplementary Explanation

If Smart Construction Simulation is not displayed on Portal, purchase a license referring to this article or contact an agent staff in charge.

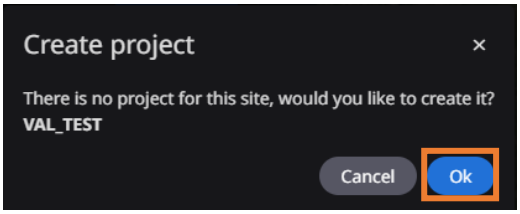
1 Press the “Smart Construction Simulation” icon after logging in Smart Construction Portal. URL https://scportal.pf.smartconstruction.com/



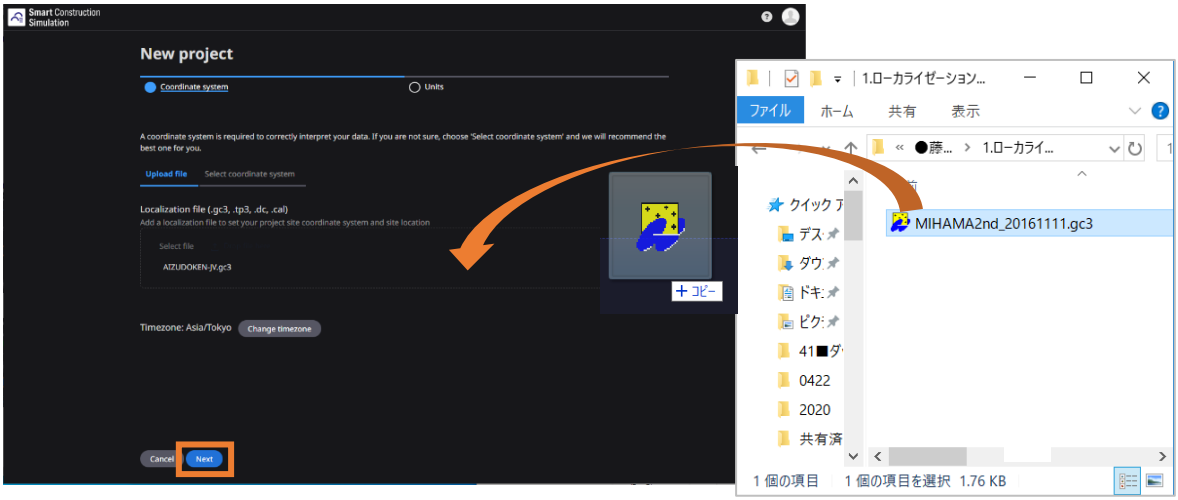
1. Select a registered project in “Jobsite Setting”.



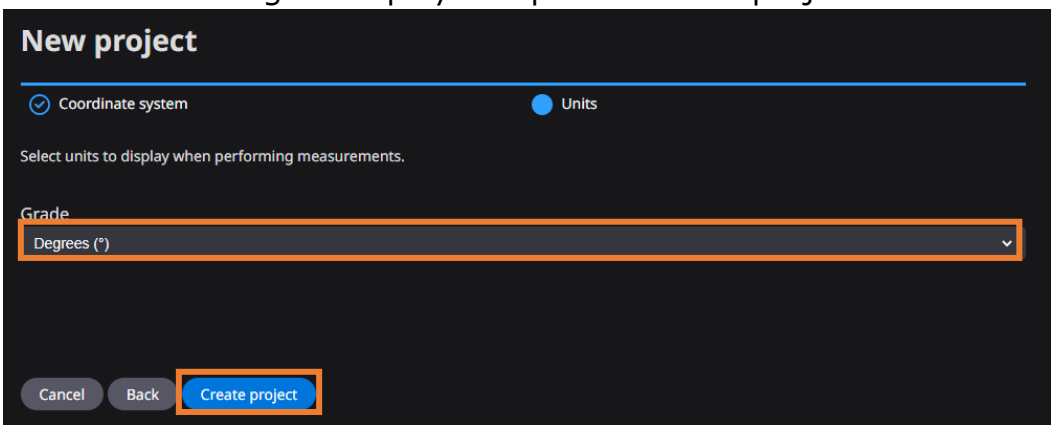
Press “OK” when the confirmation screen appears.



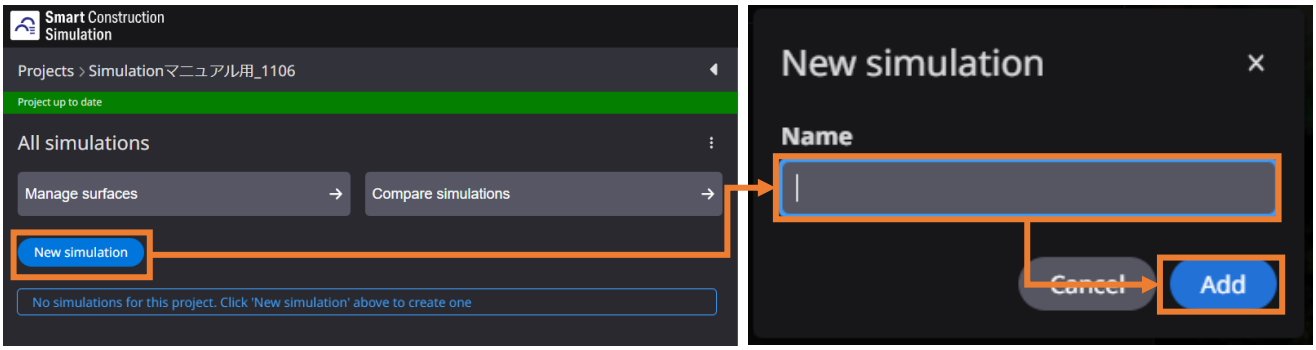
2. Select a localization file of the jobsite to be created.



3. Select the degree display and press “Create project”.



4. Press “New simulation”, enter the name, and press “Add”.

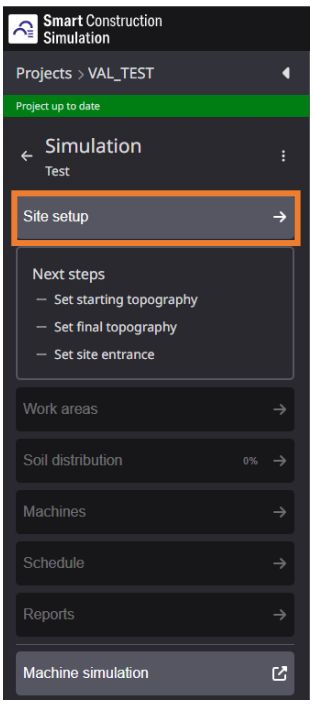


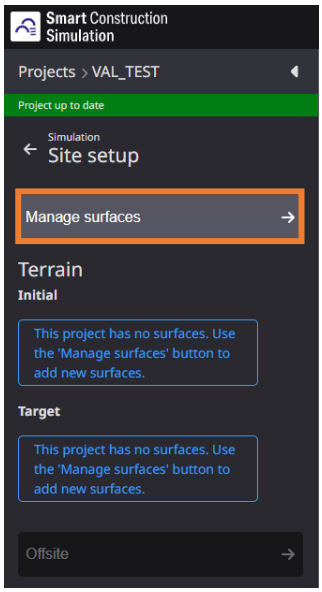
1.2 Registering Target Topography and Standard Topography

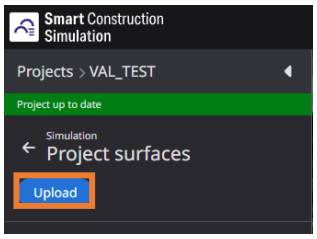
- 3D design data
- Point cloud data to be surveyed

Register all types of data like above from here. The assets will be used in the calculation of soil volume described later.

1. Press “Site setup” > “Manage surfaces” > “Upload”.





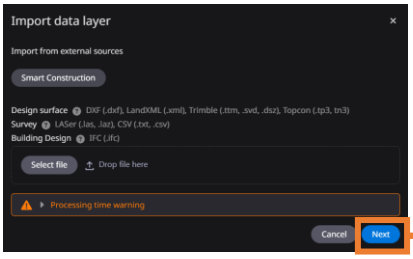


Attention

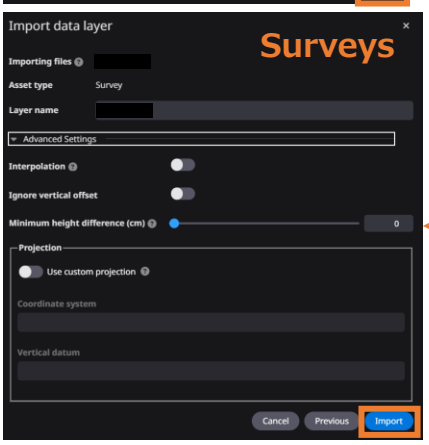
If shut down PC or close tabs while uploading, the processing will end (abort). You need to upload again.

2. Press “Select file”, and upload the design data and survey data.

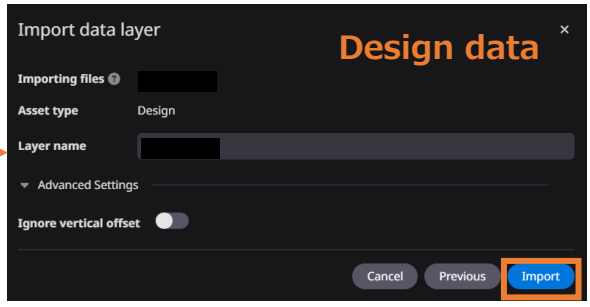
If the survey data type or decimal separator type is not selected properly, the survey data will be displayed as below.



Select files and press “Next”.

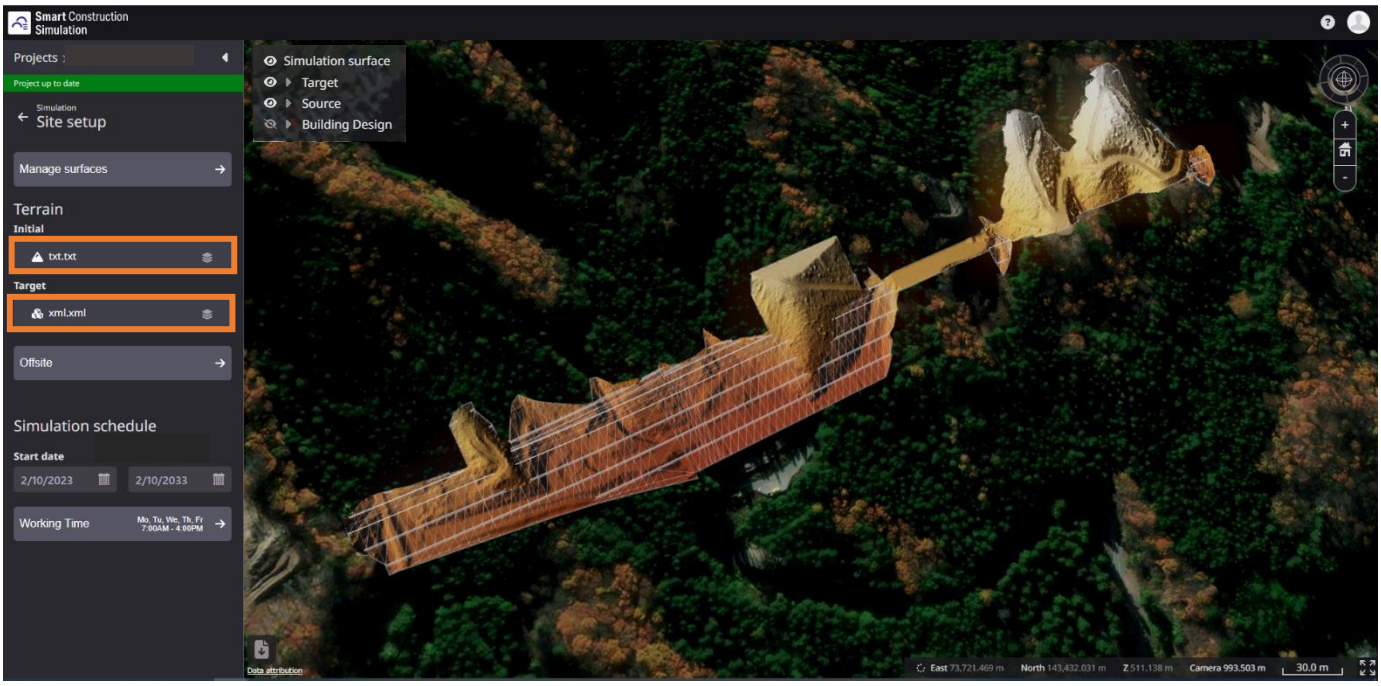


Press “Import” at the end.



Press “Import” at the end.

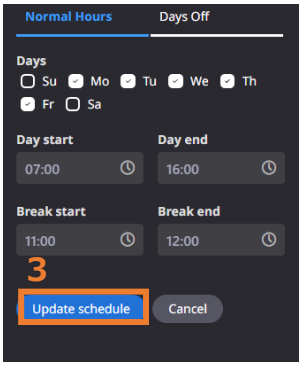
3. Allocate the uploaded files to “Initial” and “Target”.
   Please note that point cloud data and design data are not displayed if this operation is not conducted.



1.3 Setting Construction Period, Working Time, and Holidays

1. Set the start date and end date, and press “Working time”.

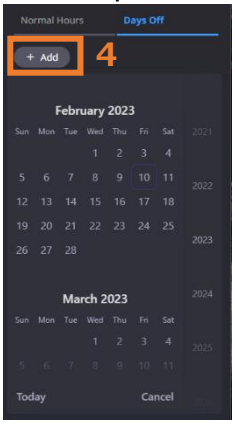
2. In the “Normal hours”, register the basic information of the construction.

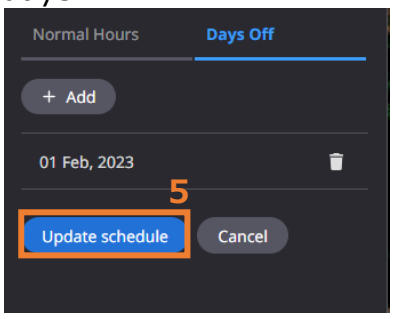


Attention

After setting, please press “Update schedule".
If you do not press, your changes will not be saved.
Press “Update schedule" once.
So we go back to the Site setup.
If you continue to set it, again “Working time" Press.

3. Set up the holidays.





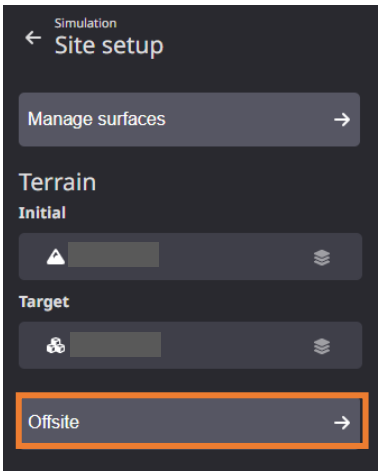
Attention

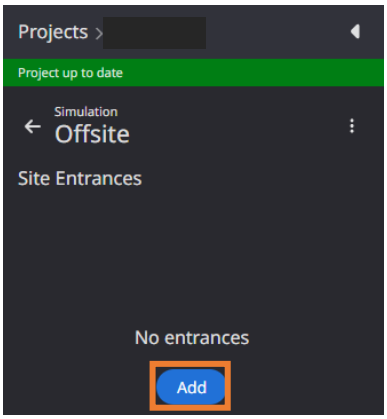
After setting, please press “Update schedule".
If you do not press, your changes will not be saved.
Press “Update schedule" once.
So we go back to the Site setup.
If you continue to set it, again “Working time" Press.

1.4 Setting the Entrance of the Jobsite

Set up the entrance of the jobsite. Regardless of whether or not there is outside export, etc., you need to set at least one location.

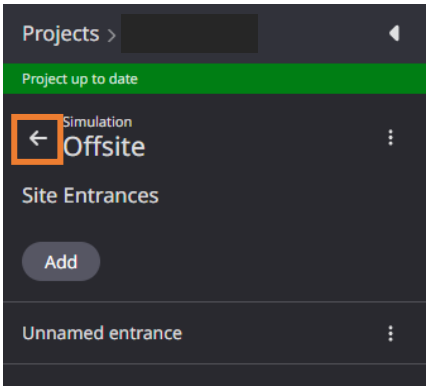
1. Press “Offsite” > “Add”.

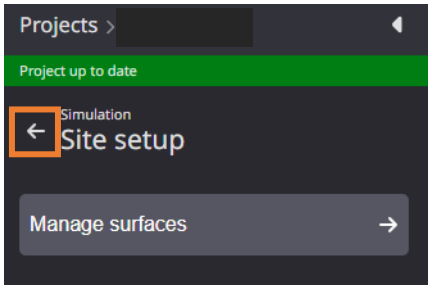




2. Click an area where you want to set as the entrance and press “Save”.
   Click within the design area.

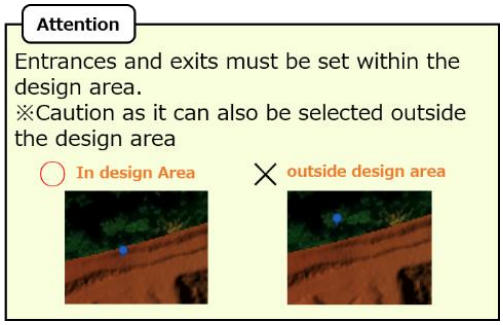
3. Return by clicking “<-” button twice after completing the “Save” action.





Attention

Entrances and exits must be set within the design area.
※Caution as it can also be selected outside the design area

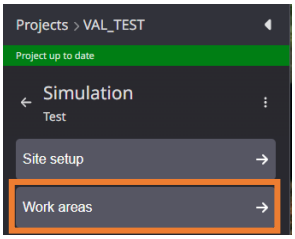


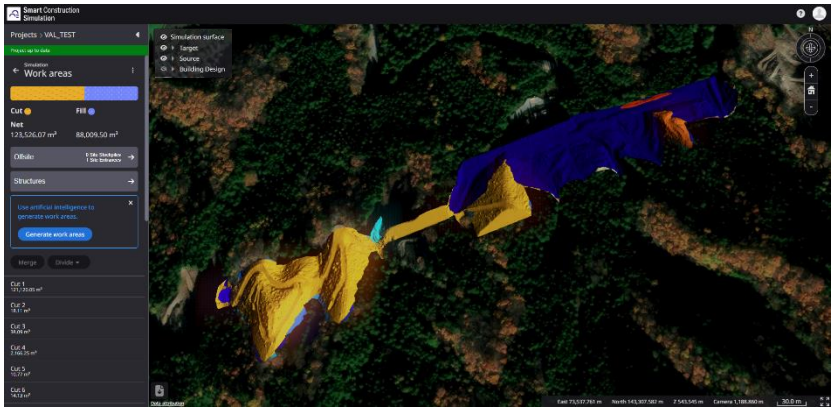
1.5 Settings of the Construction Area [Settings for Automated Division]

Note

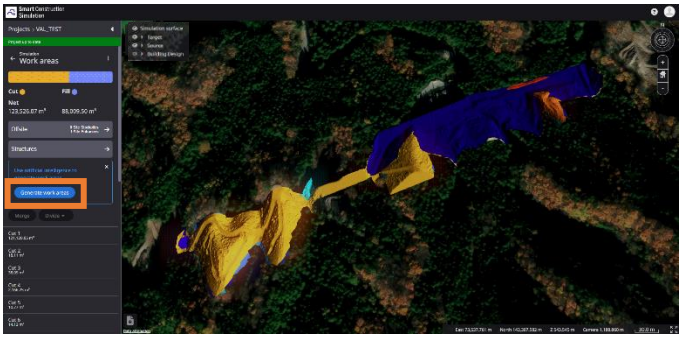
- Use pp.10-11 and/or pp.12-13 (automated division -> manual) to set the way to divide each construction area.

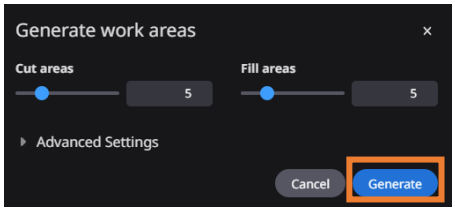
1. Press “Work areas”.
   Cut areas and fill areas are automatically identified from the topography data before construction and as-built final grade topography.



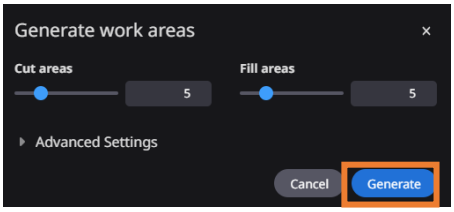


2. Press “Generate work area”.
Enter the target number of division of cut areas and fill areas respectively, and press “Generate”.(*Since it is the target number, it may be divided into the number that is more than what was specified, depending on the design date and current topography.)





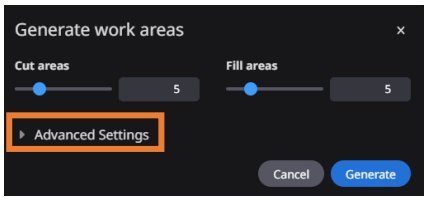
Enter number of areas to cut/fill
(Slider selection is also OK)



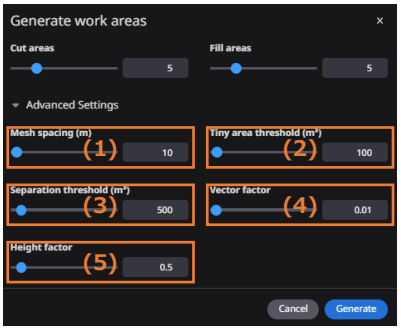
press the generate button

[Advanced Settings] Work areas Automatic Separation (Optional Function)

If using Advanced Settings for Automatic Separation of work areas, you can set up advanced split condition settings.



Press Advanced Setting



See the right.
Set values for each.

(1) Setting the mesh spacing

Specify mesh spacing for soil volume calculations. In large construction sites, increasing the mesh spacing speeds up the process by reducing the number of soil distribution calculations.

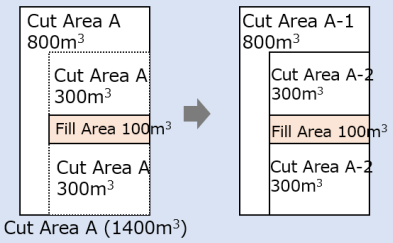
(2) Tiny area threshold

Smaller areas below the specified threshold are combined into the surrounding area.

(3) Separation threshold

without dividing below a specified threshold
It is recognized as the same area.

Example) If you set the threshold to 500m3.



The A-2 area Fill Area Between As one area, become recognized

(4) Vector factor

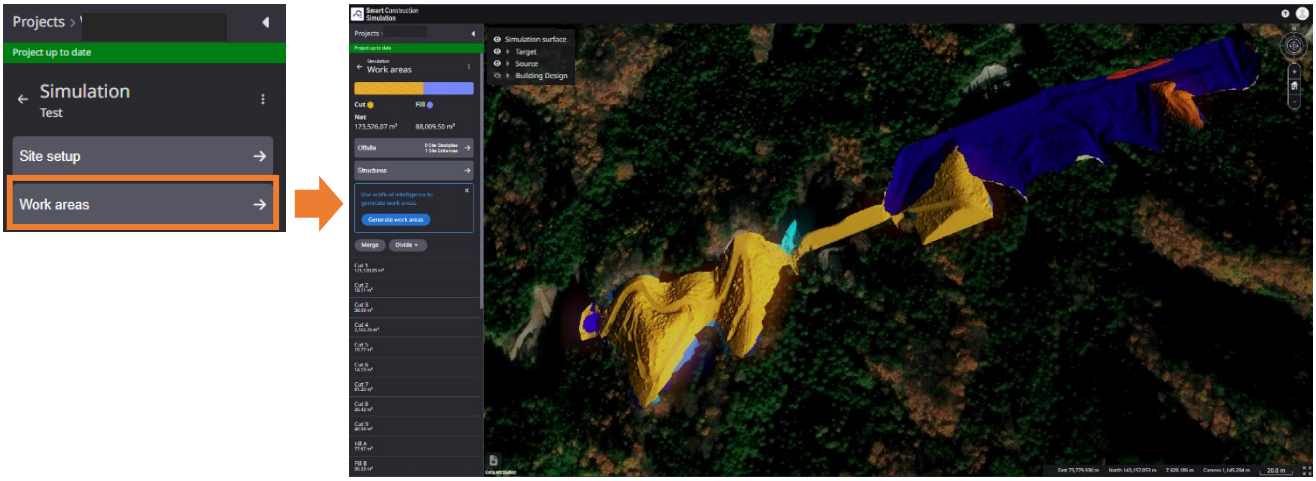
As the coefficient is increased, the the tendency of the mesh to affect the vector direction becomes stronger.

(5) Height factor

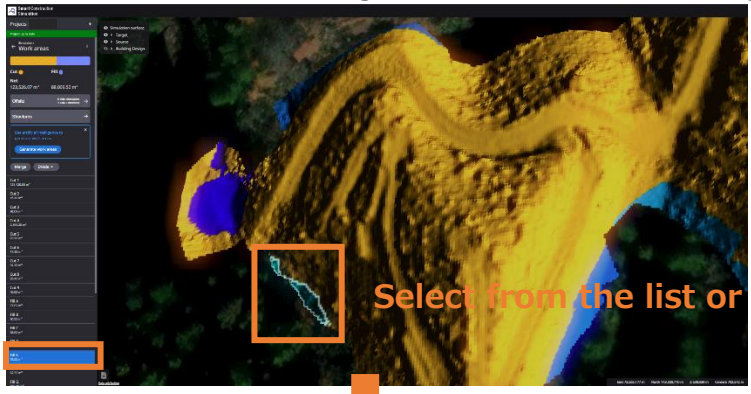
Increase the factor to make the perimeter even.
It tends to divide more.

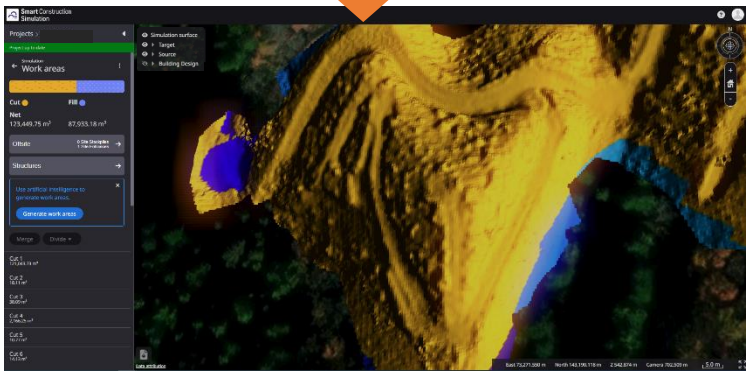
1.6 Setting the Construction Area [Manual Settings]

1. Press “Work areas”.
   Cut areas and fill areas are automatically identified from the topography data before construction and as-built final grade topography.



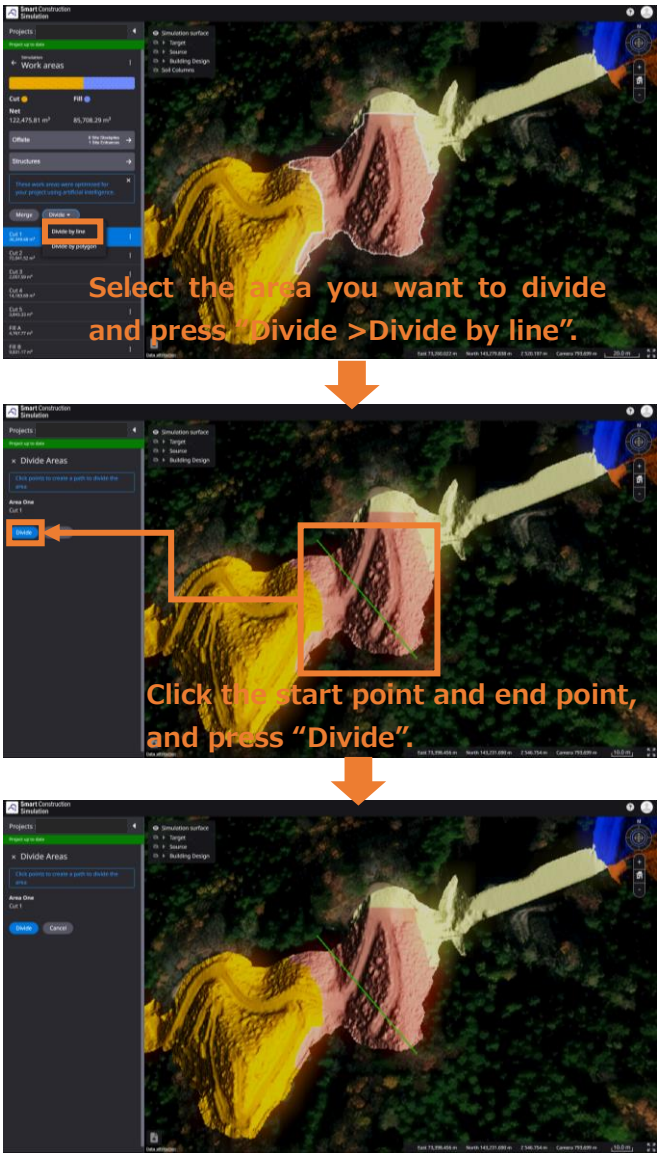
2. If a minute area is generated, it can be merged into its neighboring area.



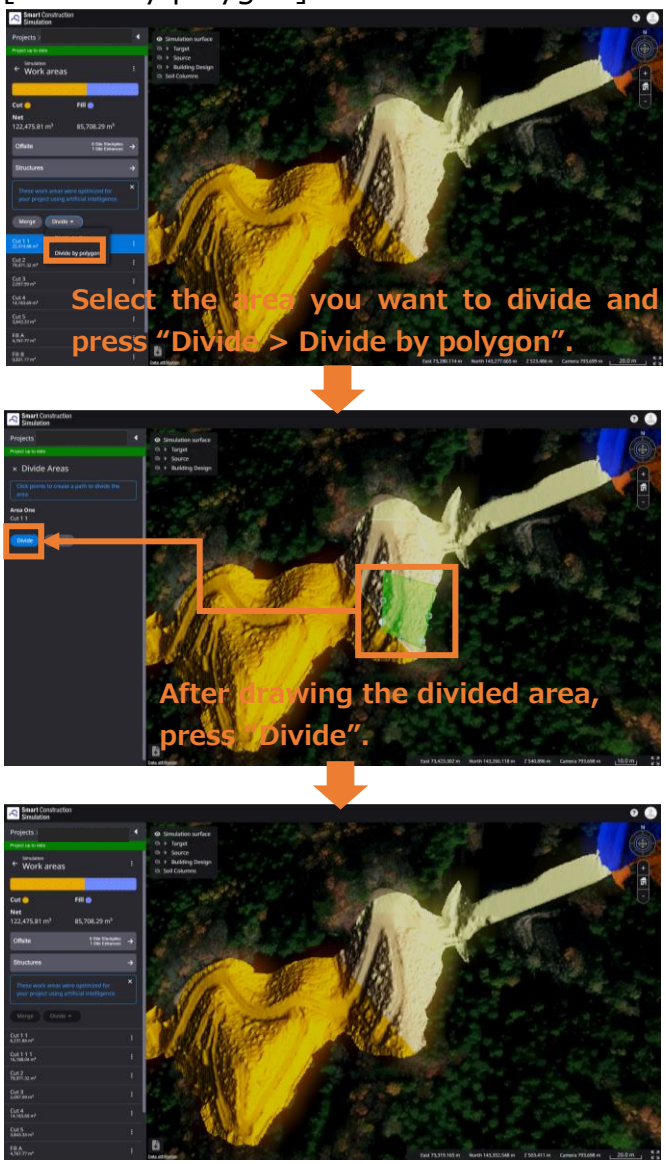


3. A large area can be divided.

[Divide by line]

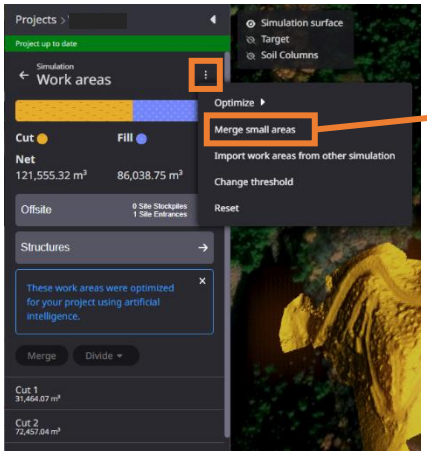


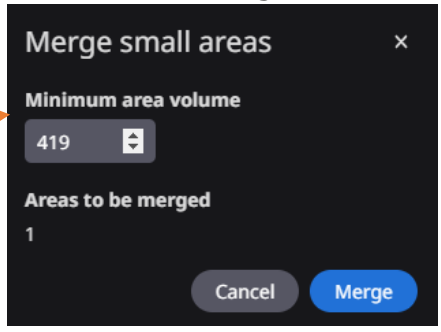
[Divide by polygon]



Supplementary Explanation

It is recommended that minute areas are merged into an area with a certain soil volume.



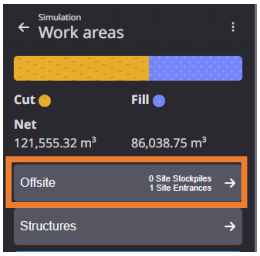


Merge of minute areas can be conducted with the above functions, too.

1.7 Setting Outside Soil-Collecting Area and Soil-Discarding Area

If there is too much soil or it is in shortage:
Set a soil-collecting area and a soil-discarding area, because it is needed to discard the soil outside the jobsite or transport the soil from outside.

1 Press “Offsite”.



Attention

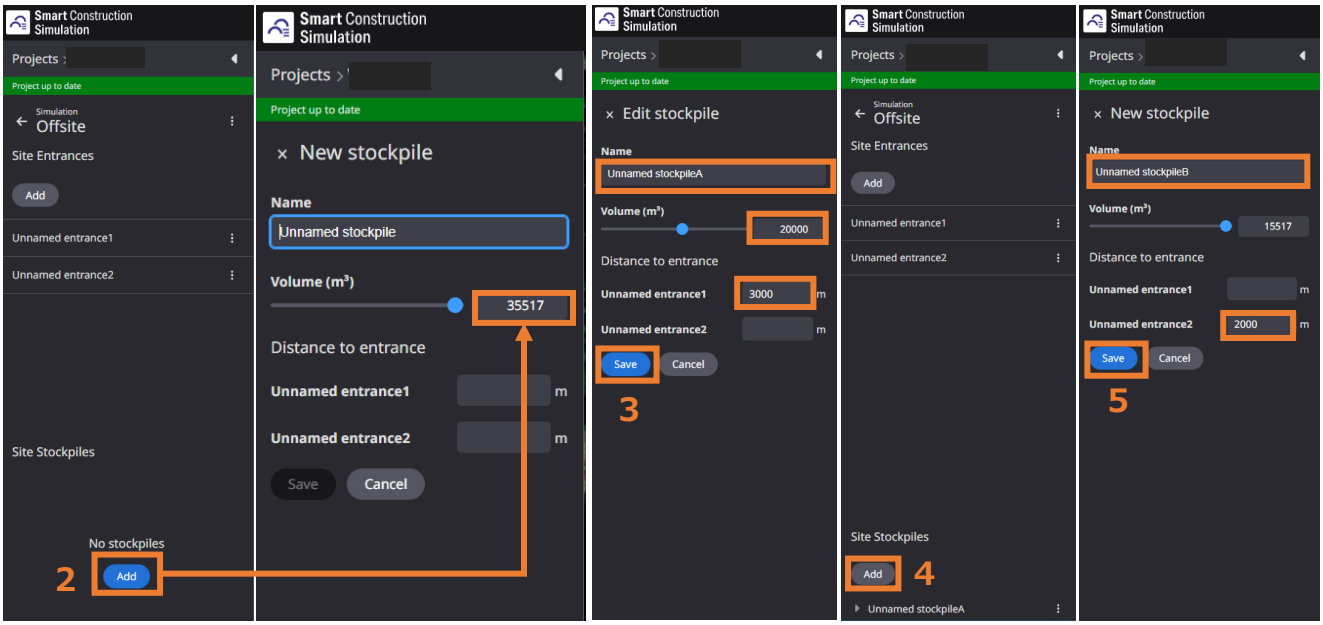
About the Distance from the Entrance
Later (on the construction machine simulation side), the details
You can enter approximate distances.

2 Press “Add”.
Soil volume in excess within the jobsite or in shortage will be displayed.
In this case, soil volume that is in excess, 36,930 (m^3) is displayed.

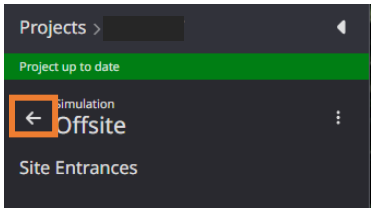
3 Enter the name of the soil-discarding area, soil volume to be discarded in that area, and distance from the entrance, and press “Save”.
In this case, the plan shall be discarding 20,000 m^3 in the soil-discarding area A, and the remaining soil in the soil-discarding area B.

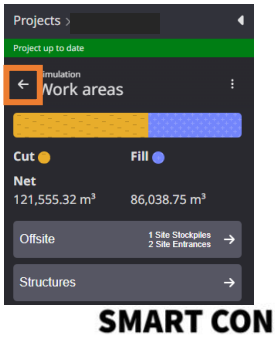
4 Since the soil-discarding area B needs to be added, press “Add”.

5 Enter the name of the soil-discarding area and distance from the entrance, and press “Save”. The soil volume, 36,930-20,000=16,930(m^3) is automatically entered.



6 Return by clicking “<-” button twice after completing the “Save” action.





Attention

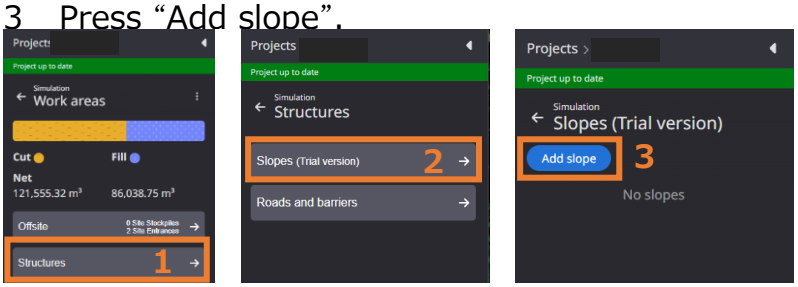
After stockpile has been set, work area settings may require stockpile to be reconfigured.

1.8 Setting Up the Operation Unit in Slope

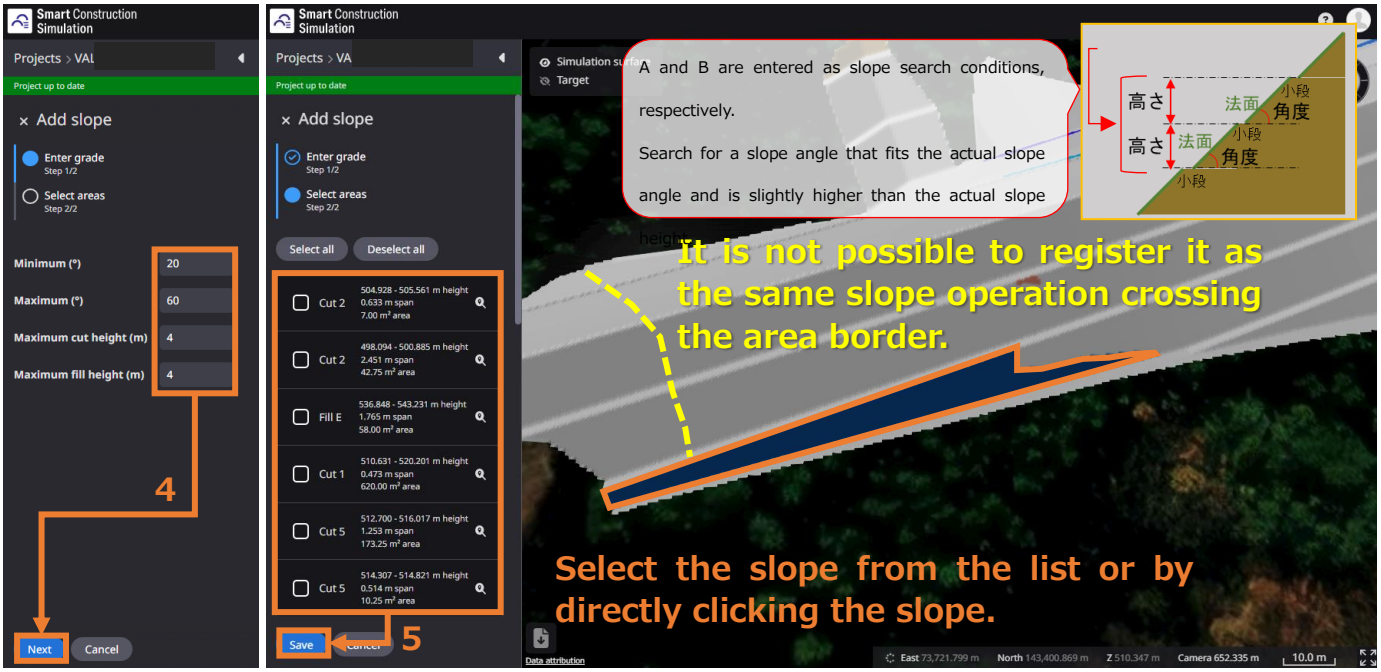
Note

This function (slope operation) is currently under development. There may be malfunctions. Please keep it in mind.
If you want to create a simulation distinguishing the slope operation from soil-distribution operation, a registration is required.
Without registration, the slope in each area will not be recognized as a slope and the calculation of simple soil distribution will be conducted.

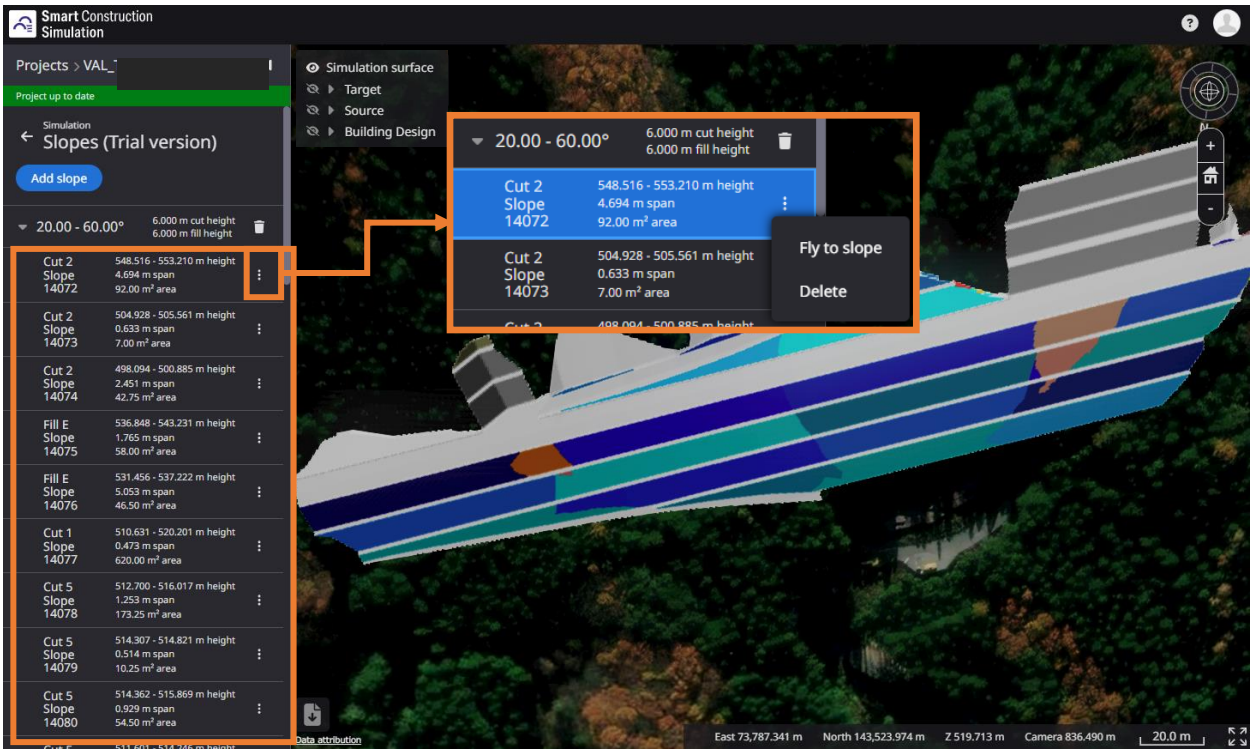
1 Press “Structures”.
2 Press “Slopes(Trial version)”.
3 Press “Add slope”.



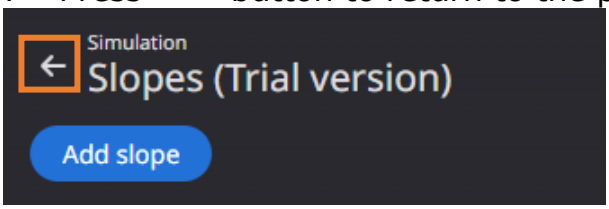
4 Specify the maximum and minimum degrees of the slope and the vertical direction height, and press “Next”.
Slope that matches the search conditions will be colored.
5 Select the one for registering as the slope operation and press “Save”.
You can select the slope in the list on the left side of the screen or directly click the slope.



6　Registration of the slope completed.
You can zoom in the display of the slope position or cancel the registration with the “Delete” button.



7　Press “<-” button to return to the previous screen.



Attention

If area splitting or merging is performed after the slope has been set, unexpected events may occur.

・The set slope area is not recognized correctly.

Slope setting should be performed after dividing the area.

Attention

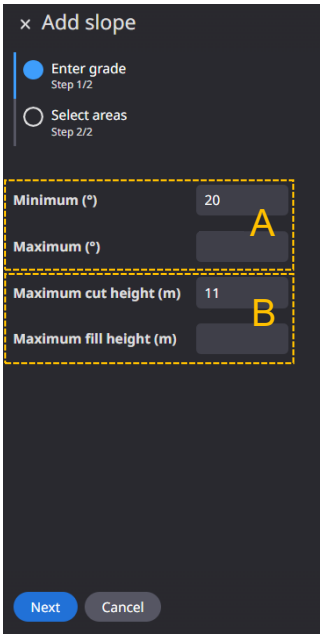
If area splitting or merging is performed after the slope has been set, unexpected events may occur.

・Slope setting data is reset.
・Empty slope data remains.

Slope setting should be performed after dividing the area.
f this event occurs, please delete the data and then reconfigure the slope.

Deleted

[Column] Tips for setting the slope search conditions



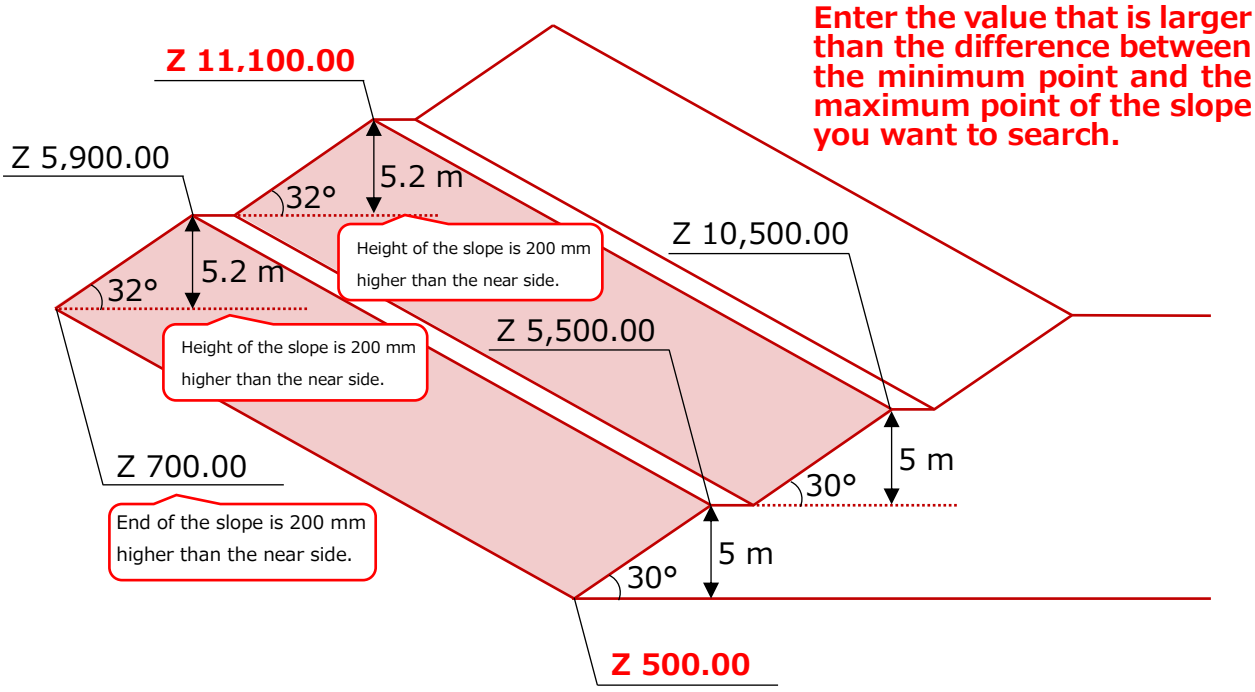
For the slope search, specify the maximum and minimum degrees of the slope [A] and the vertical direction height of the slope [B].

If you want to register the slope of the hatched part as the operation unit in the cut soil slope as below, you can conduct the search by, for example, entering the following:

A Minimum (°)...20
Maximum (°)...40

B Maximum cut height (m)...11

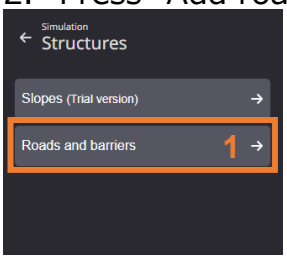
*Maximum fill height is not related to the search of the cut soil slope. You can search it without filling out.
*You can select more slopes by expanding the scope of search.

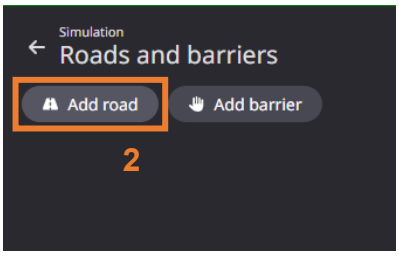


1.9 Setting the Priority Route

Set it up in the case the route for soil movement has already been determined.
If you do not set it up, the minimum distance of soil travel route will be automatically set, considering the grade.

1. Press “Roads and barriers”.
2. Press “Add road”.



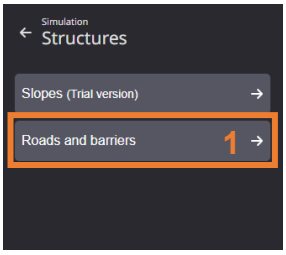


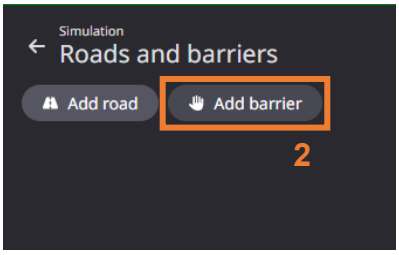
3. Draw a line while clicking inside the design area and fix the drawing with a right click.
4. Change the name as needed and press “Save”.
5. Draw another route, edit, and delete the same as needed.

1.10 Setting up Barriers

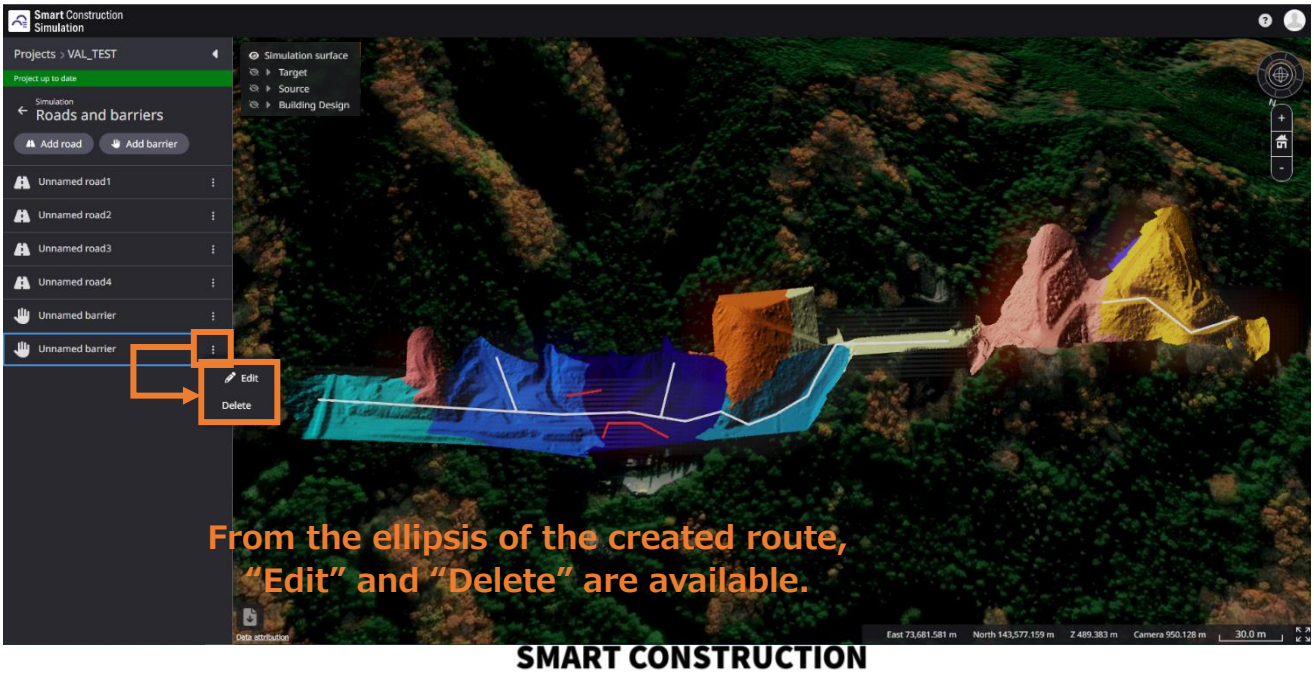
Set them up if there are barriers in the jobsite.

1. Press “Roads and barriers”.
2. Press “Add barrier”.





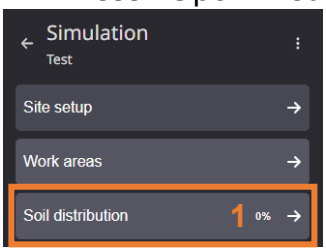
3. Draw a barrier inside the design area and fix the drawing with a right click.
4. Change the name as needed and press “Save”.
5. Draw another route, edit, and delete the same as needed.

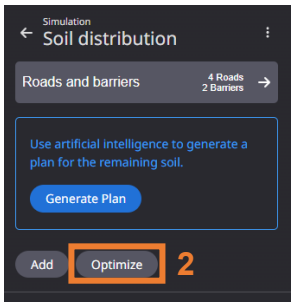


Note

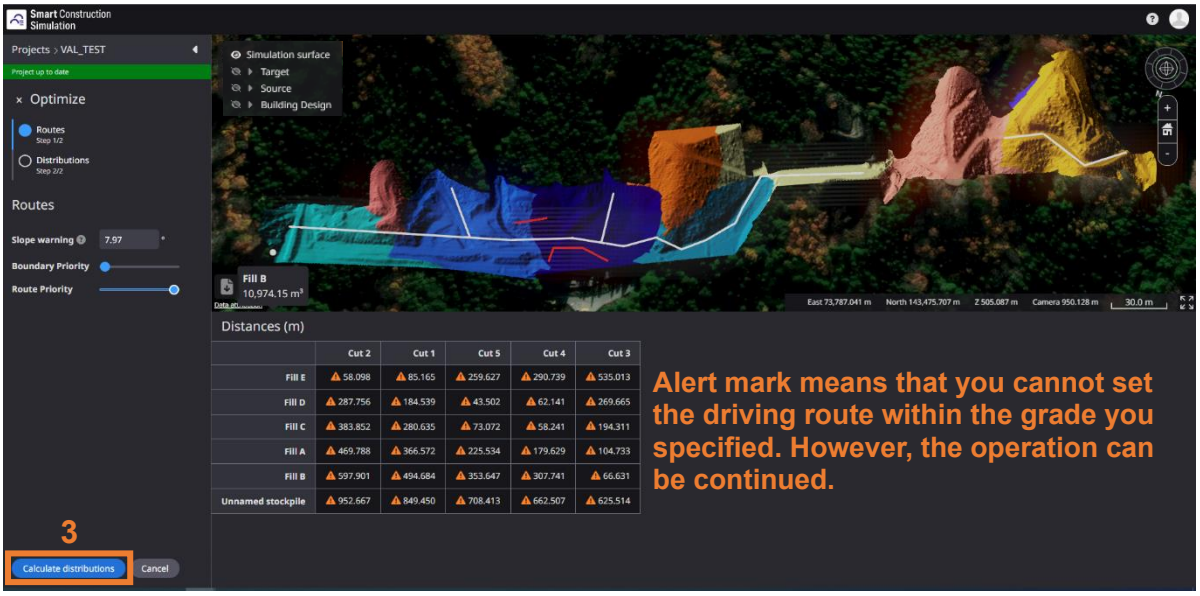
- Conduct a soil volume distribution planning of each construction area in one of the method among P21-P22, P25-P26, or P27.
- Process of slope operations registered on P16 will not be reflected, if optimized soil distribution calculation mode is applied.

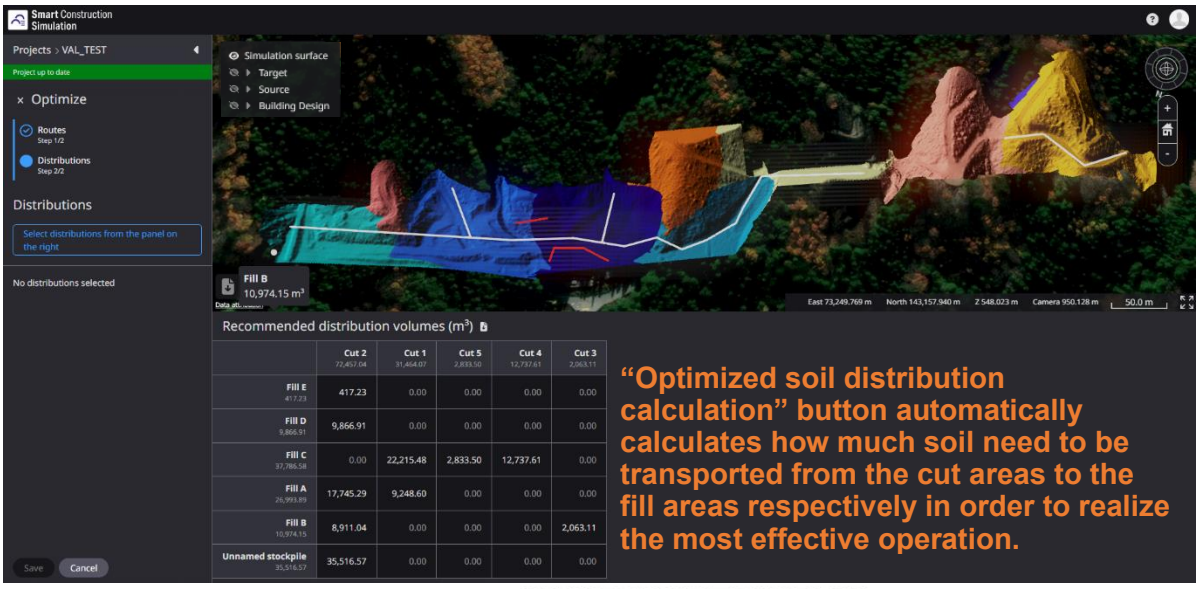
1. Press “Soil distribution”.
2. Press “Optimized”.





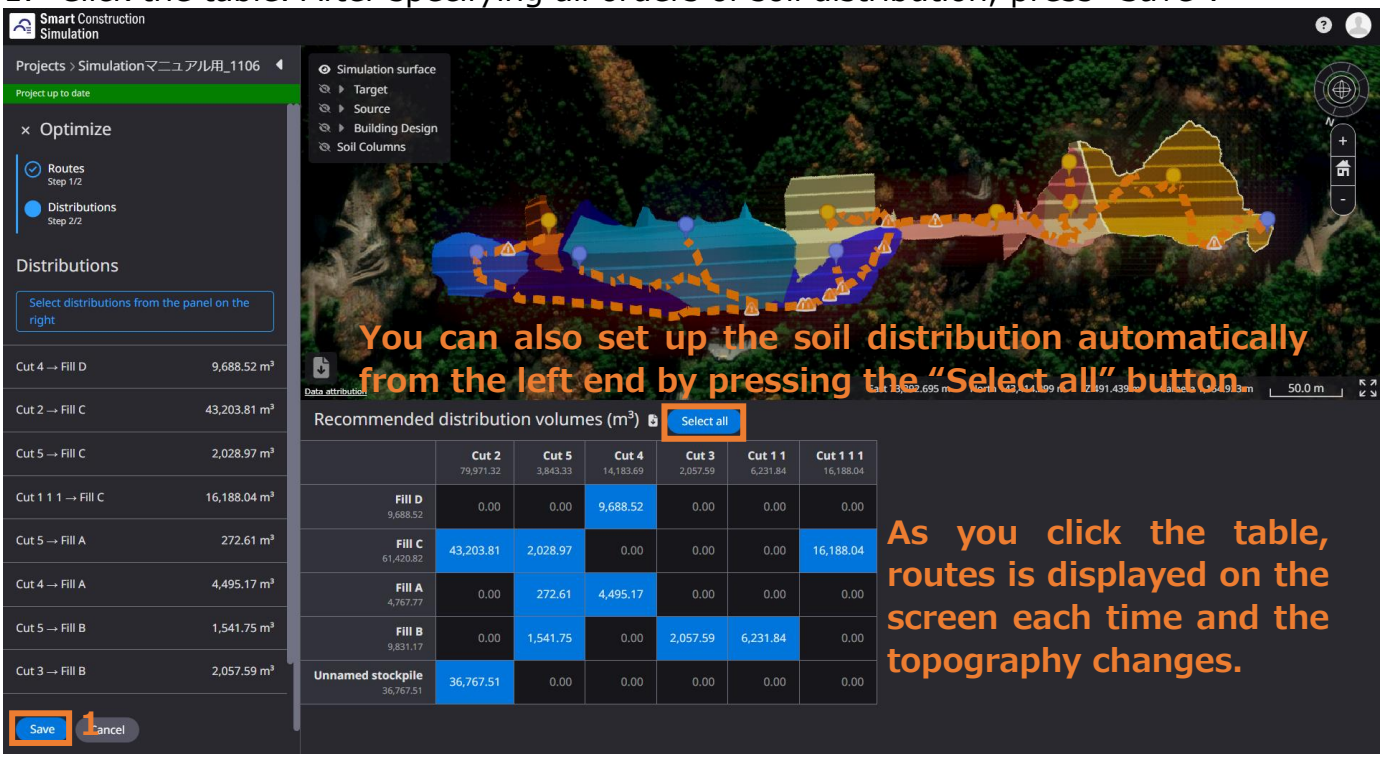
3. Press “Calculate distributions”.



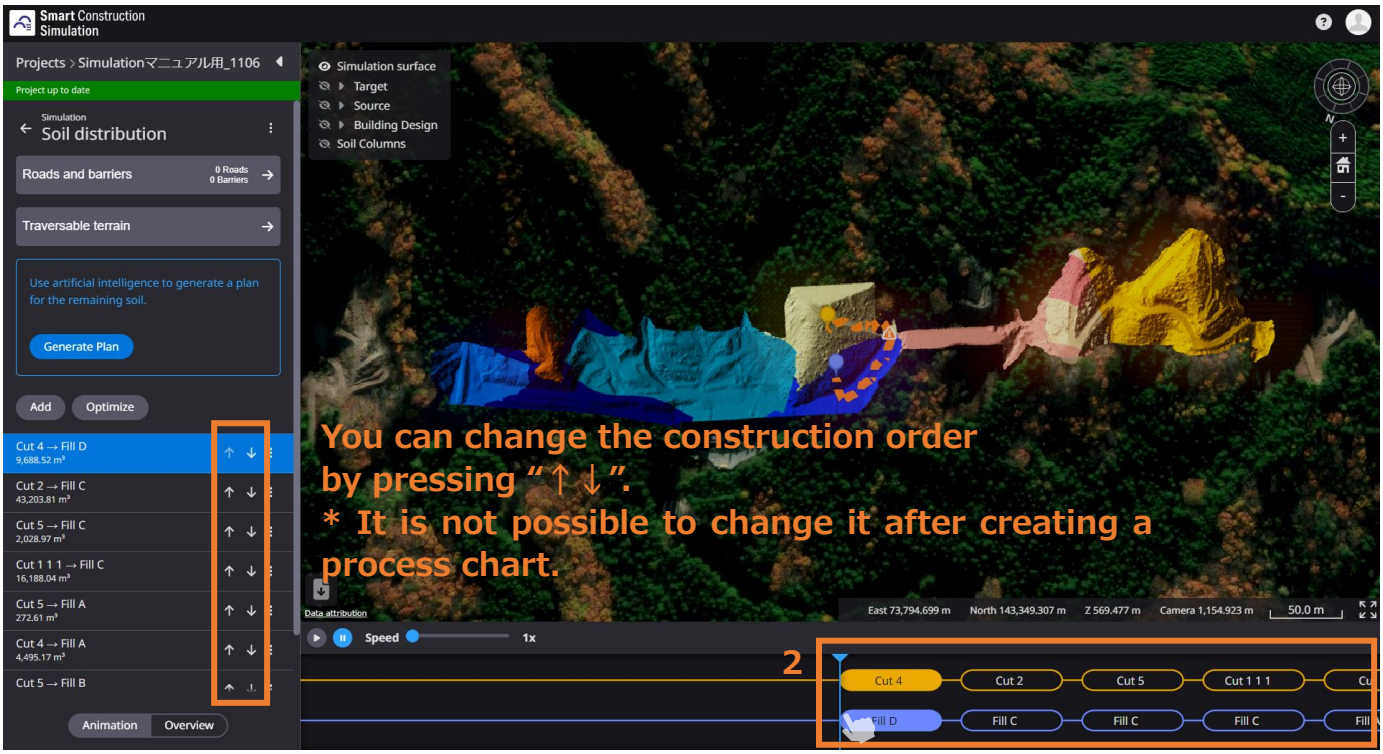


1.11.1 Defining procedures for soil distribution

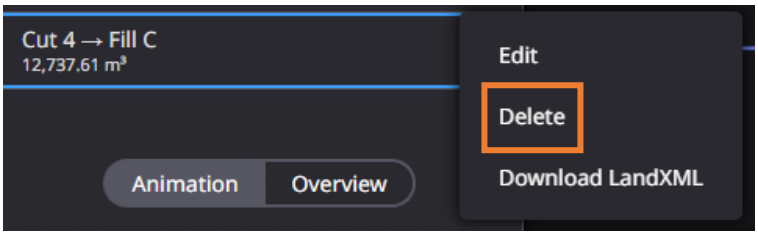
1. Click the table. After specifying all orders of soil distribution, press “Save”.



2. Click the time slider and move it to the right and left to check the change in topography per procedure.



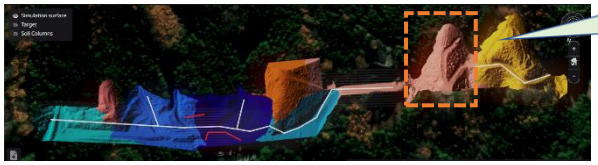
If you want to delete the procedures you defined, you need to perform either of delete in order from the last procedure or batch delete from the selected procedure to the last one.If you want to delete the procedures you defined, you need to perform either of delete in order from the last procedure or batch delete from the selected procedure to the last one.



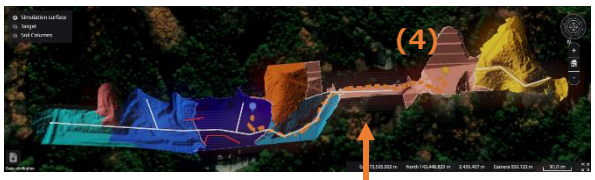
[Column] Tips for Volume Distribution Setting

After dividing one area into multiple areas in the height direction, the construction sequence is set.

Example) Cut Area 1 is constructed first to any terrain, and after the completion of construction for other areas.
To construct the remaining part of a cut area 1.
(Up to Clause 3, P21, “Optimize", see below after implementation)

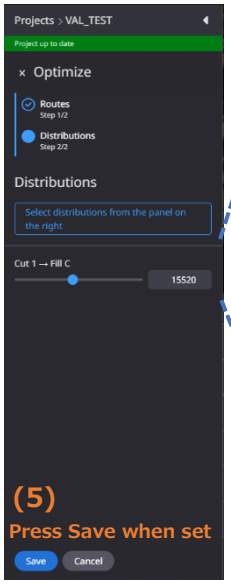


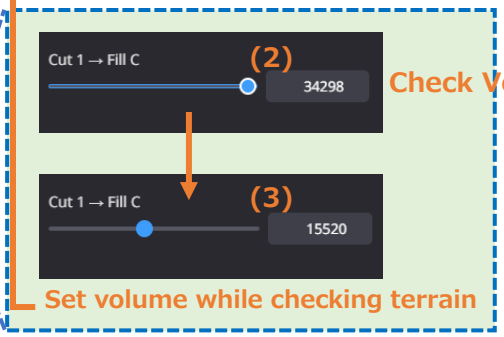
Construct Area 1 (pink area) until construction equipment can enter Area 2 (yellow area).



Recommended distribution volumes (m^3)

	Cut 2 72,039.81	Cut 1 34,297.57	Cut 4 12,737.61	Cut 3 2,063.11
Fill D 9,866.91	0.00	9,866.91	(1) 0.00	0.00
Fill C 37,786.58	9,529.35	15,519.62	12,737.61	0.00
Fill A 26,993.89	26,993.89	Select Target Area		
Fill B 10,974.15	0.00	8,911.04	0.00	2,063.11
Unnamed stockpile 35,516.57	35,516.57	0.00	0.00	0.00

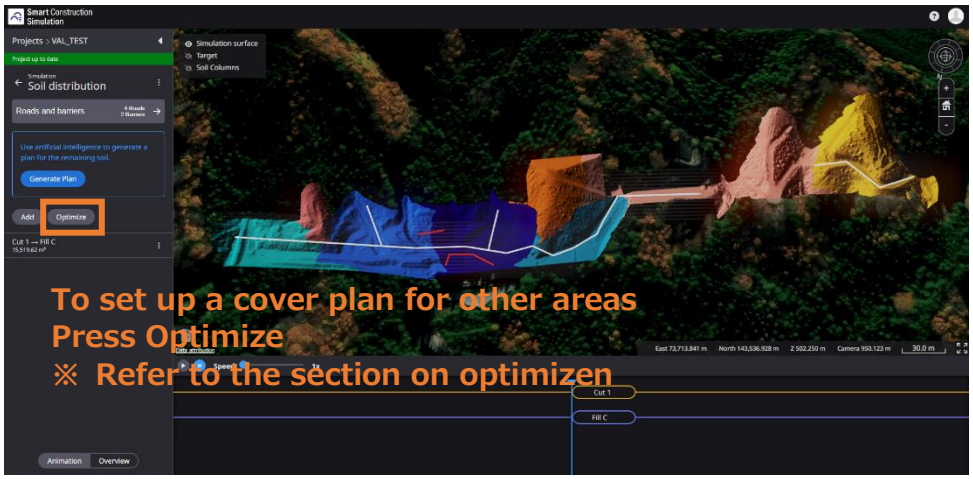




Attention

When setting any volume,
You can set a lot.
If set too many, an error occurs
Do not set it.

Provides insight into volume combined with terrain
Accurate planning is possible!

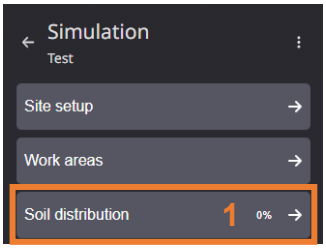


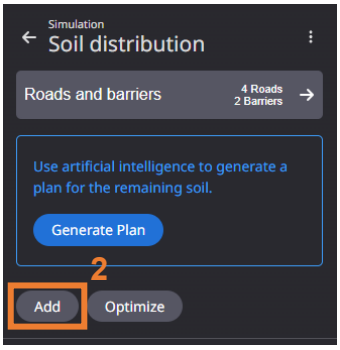
1.12 [Manual settings] Planning Soil Volume Distribution of Each Construction Area

Note

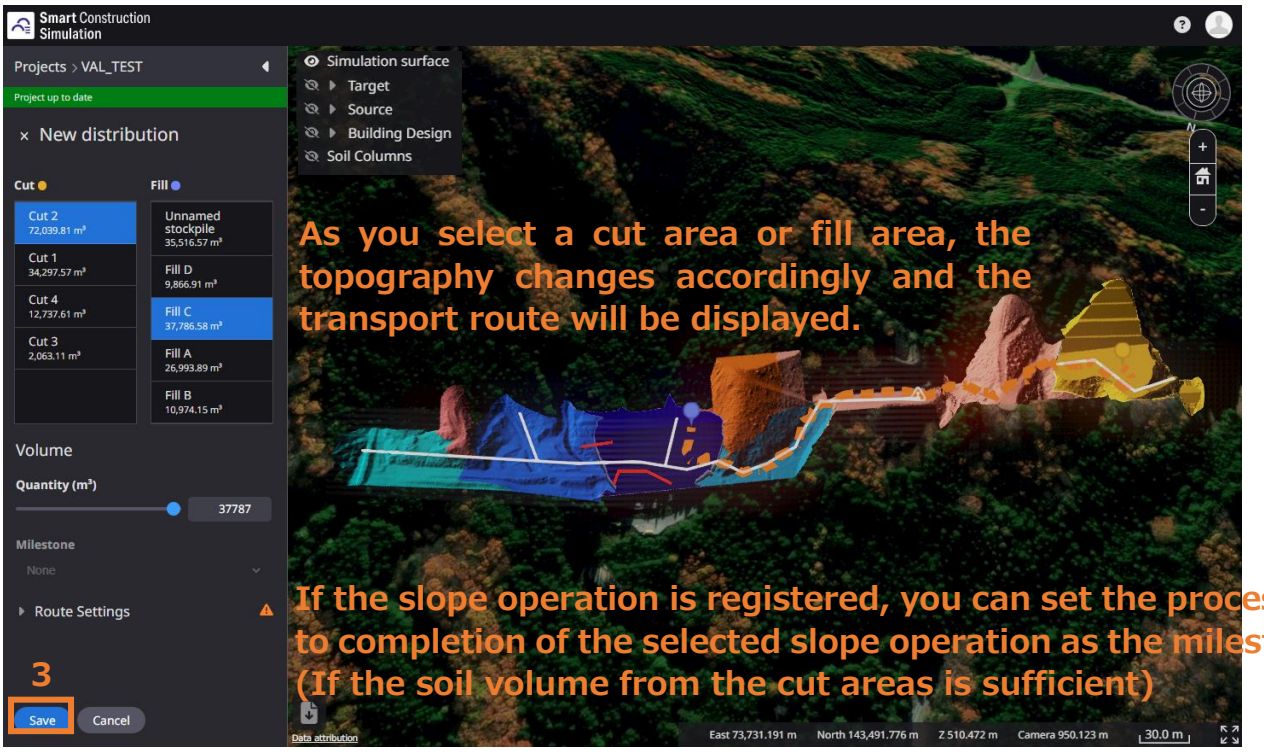
If you register the slope on P16, the slope operation is reflected through planning the soil volume distribution in the manual mode.

1. Press “Soil distribution”.
2. Press “Add”.





3. Cut areas and fill areas are displayed. So, select the procedures as you like and press “Save”.



Attention

Do not use the quantity slider if you are registering slope work.
(The soil volume will be incorrect.)

If you want to break it up into multiple registrations, use the milestone.

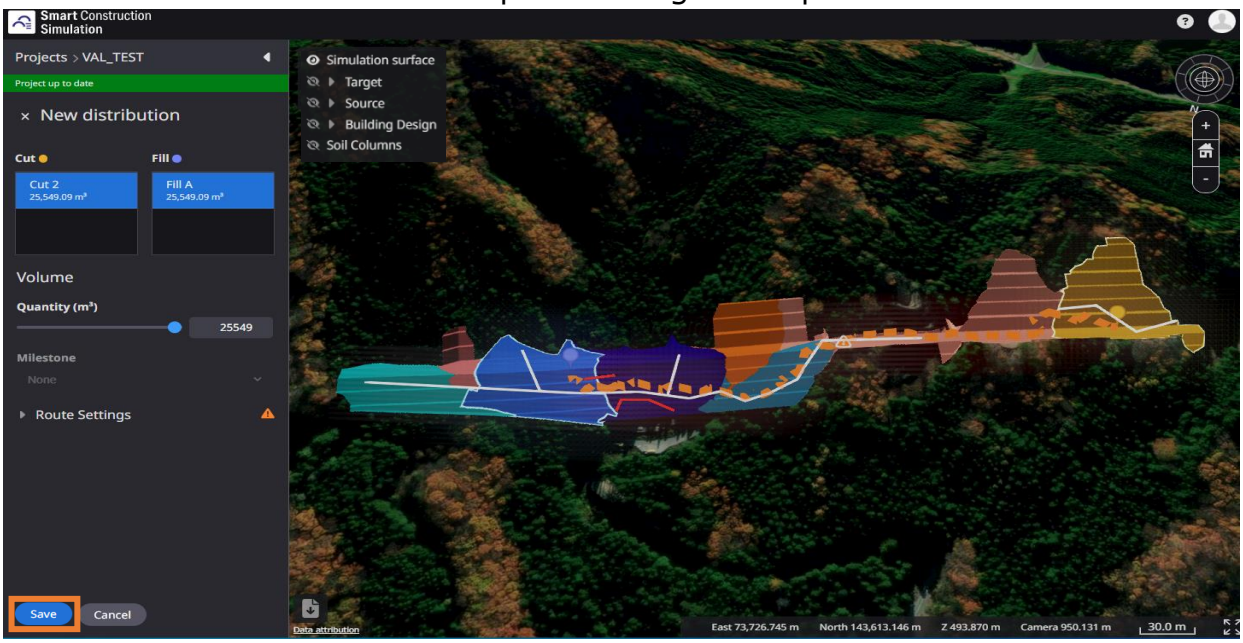
Attention

When selecting an area, select from the List.
Select from 3D viewer
・The volume quantity bar value is incorrect.
・Duplicate registrations may occur because areas that have already been set up can also be selected.

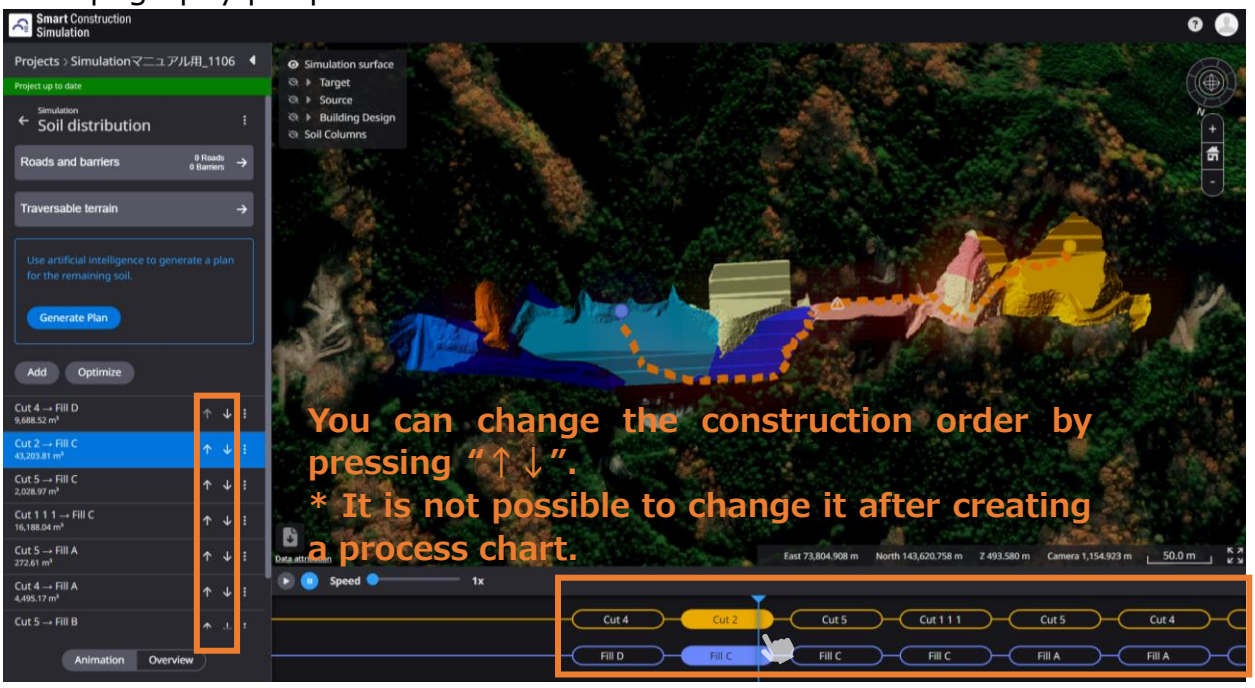
If you choose from the 3D viewer, please press "Cancel" at the bottom left and select again.

1.12.1 Defining procedures for soil distribution

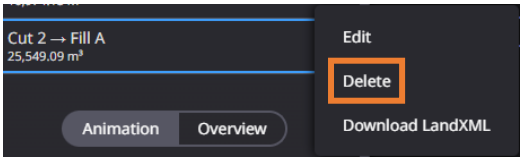
1. Save all the soil distribution pairs through the operations on P25.



3. Click the time slider and move it to the right and left to check the change in topography per procedure.



If you want to delete the procedures you defined, you need to perform either of delete in order from the last procedure or batch delete from the selected procedure to the last one.If you want to delete the procedures you defined, you need to perform either of delete in order from the last procedure or batch delete from the selected procedure to the last one.



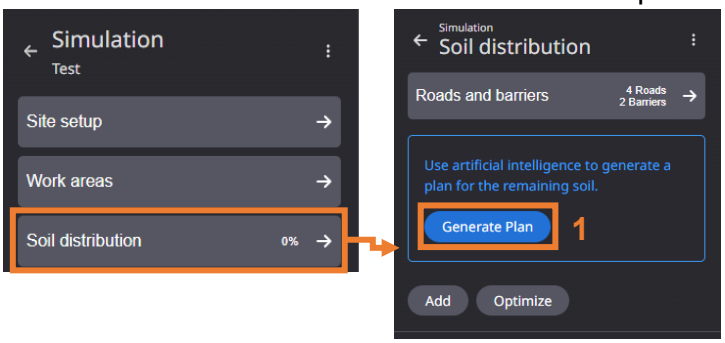
1.13 [Construction Order AI] Planning Soil Volume Distribution of Each Construction Area

Note

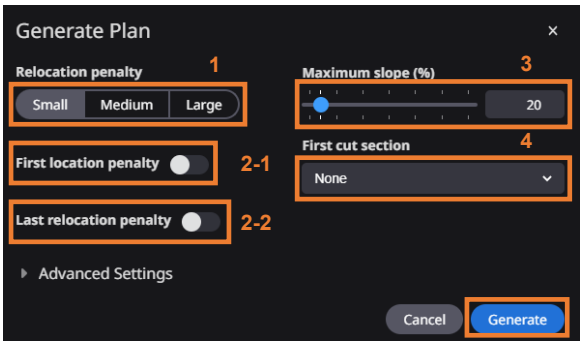
This function is currently under development. Please understand that it may take several days for calculation.

If you use this function, you can determine the construction order using AI-optimized calculation.

1. Press “Soil distribution” > “Generate plan”.



2. Setting screen opens. So, set up the parameters as needed, and press “Generate”.



Refer to the right.
with terms 1,2,3,4 set
Press Generate.

1. Indicators for determining construction order

■Small
The work quantity minimum (load carrying quantity × distance = minimum) is given priority from the work area to decide the next work area.

■Large
To determine a next work area by giving priority to ease of movement from the work area.

(* Reduce the amount of work as much as possible, taking ease of movement into consideration. The overall workload will be greater than "small.)

2. Setting the Construction Sequence Taking Entrance Into Account

2-1
When ON is selected
Construction starts near the entrance.

2-2
When ON is selected
construction ends near the entrance.

3. Setting the maximum slope for Dump

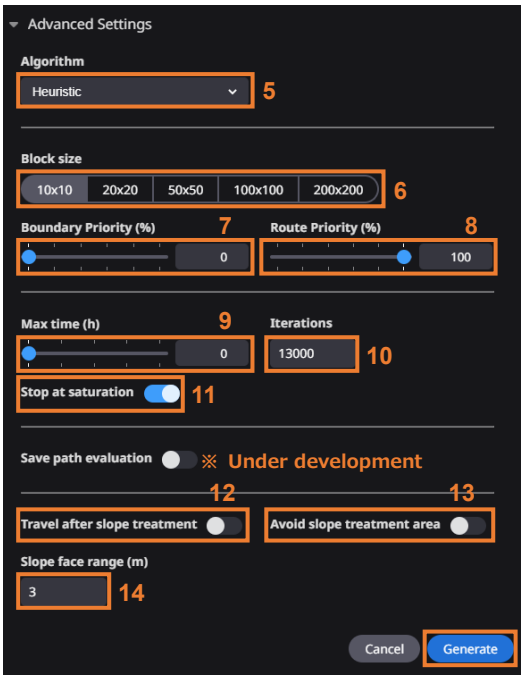
Set allowable slope for running dumps

4. Setting Construction Start Locations

Construction starts from the designated area.

[Advanced] Construction Order AI (Optional Function)

Using Advanced Settings in Construction Sequence Settings Using AI
You can set up detailed construction order settings.



See below for the right.
Set each item
Press Generate.

5. Setting AI Methods

Heuristic Recommended
(The other methods are currently used for longer calculation time.)

■Heuristic
Calculate the work order with the least amount of work based on the results of pre-computed optimization allocation calculations.

■Heuristic + Annealing
Searches for the construction order with the least amount of work, although it takes longer to converge.

■Heuristic + PWUCT , PCBCUCT
Intermediate level between the above two

6. Setting Up Calculated Minimum Units

The larger the size, the faster the calculation is completed. On the other hand, the difference in elevation along the route also increases, making it difficult to find the soil transport route.

7. Set Run Priority

The degree to which a notch is given priority when searching a course

8. Set Run Priority

The degree to which the designated priority road is used

9. Max Time
10. forced termination threshold
11. For ON, calculate until convergence
When OFF, calculation is performed up to the number set by “10”

12. Setting the Slope Construction Order

When ON, the slope of the area where the soil conveyance is completed is continuously constructed
When OFF, slope construction is carried out at appropriate timing until construction is completed

13. Setting the Dump Path for Slope Construction

When ON, the slope is not a dump track.
When OFF, the dump path is set regardless of the slope.

14. Setting the Dump Path around the Slope

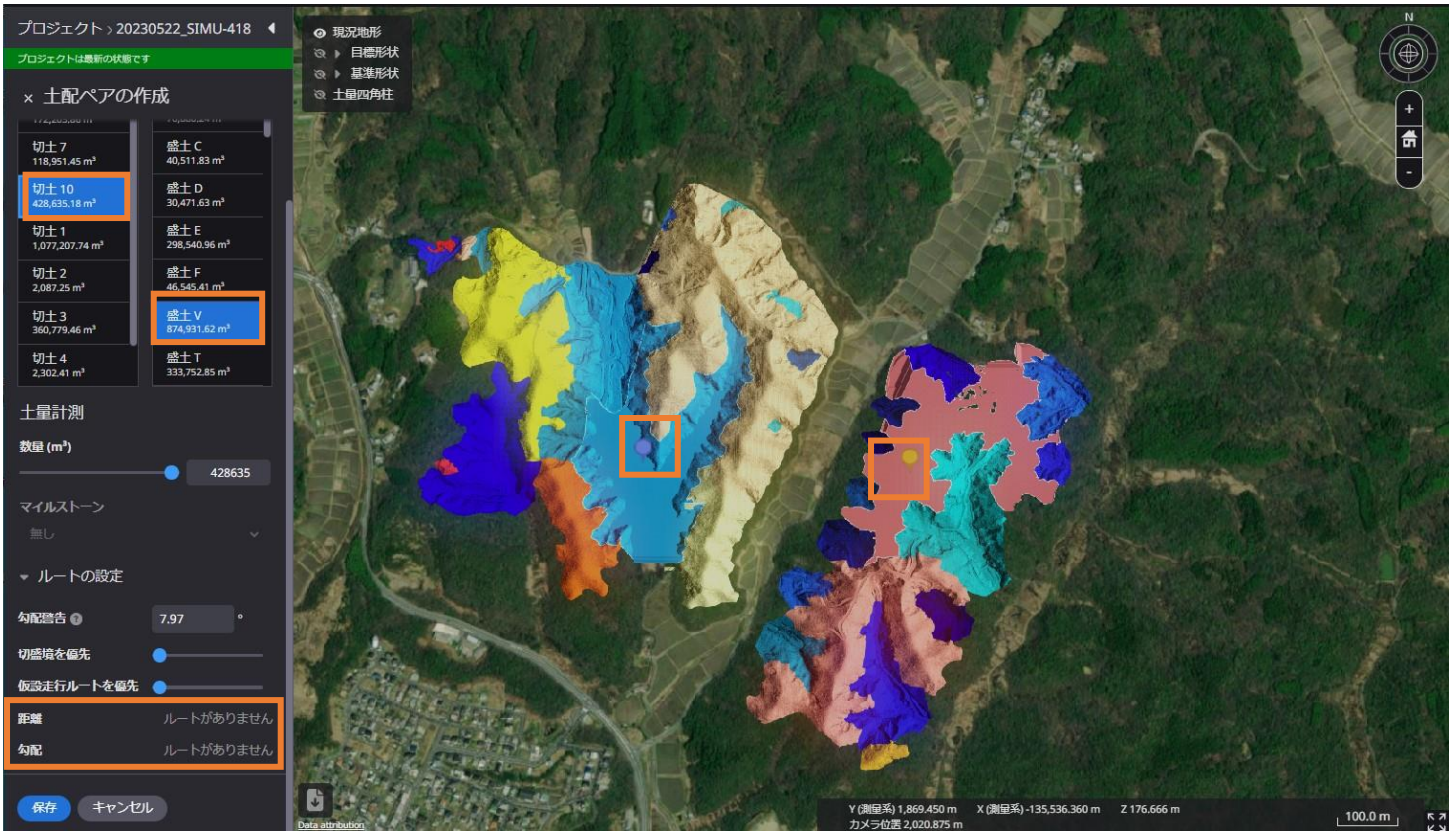
Set the distance from the slope where dump driving is prohibited.

Add the function of traveling area settings

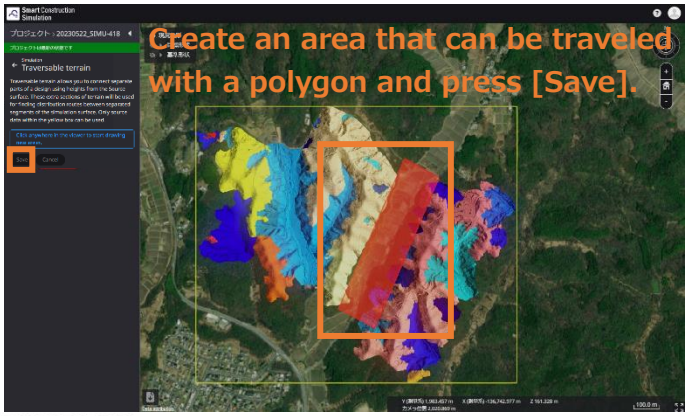
Note
If the area is further away from the source area, this function is not applicable.

By using this function, it is possible to set soil transport through a hypothetical topography area, even if the design model is physically apart.

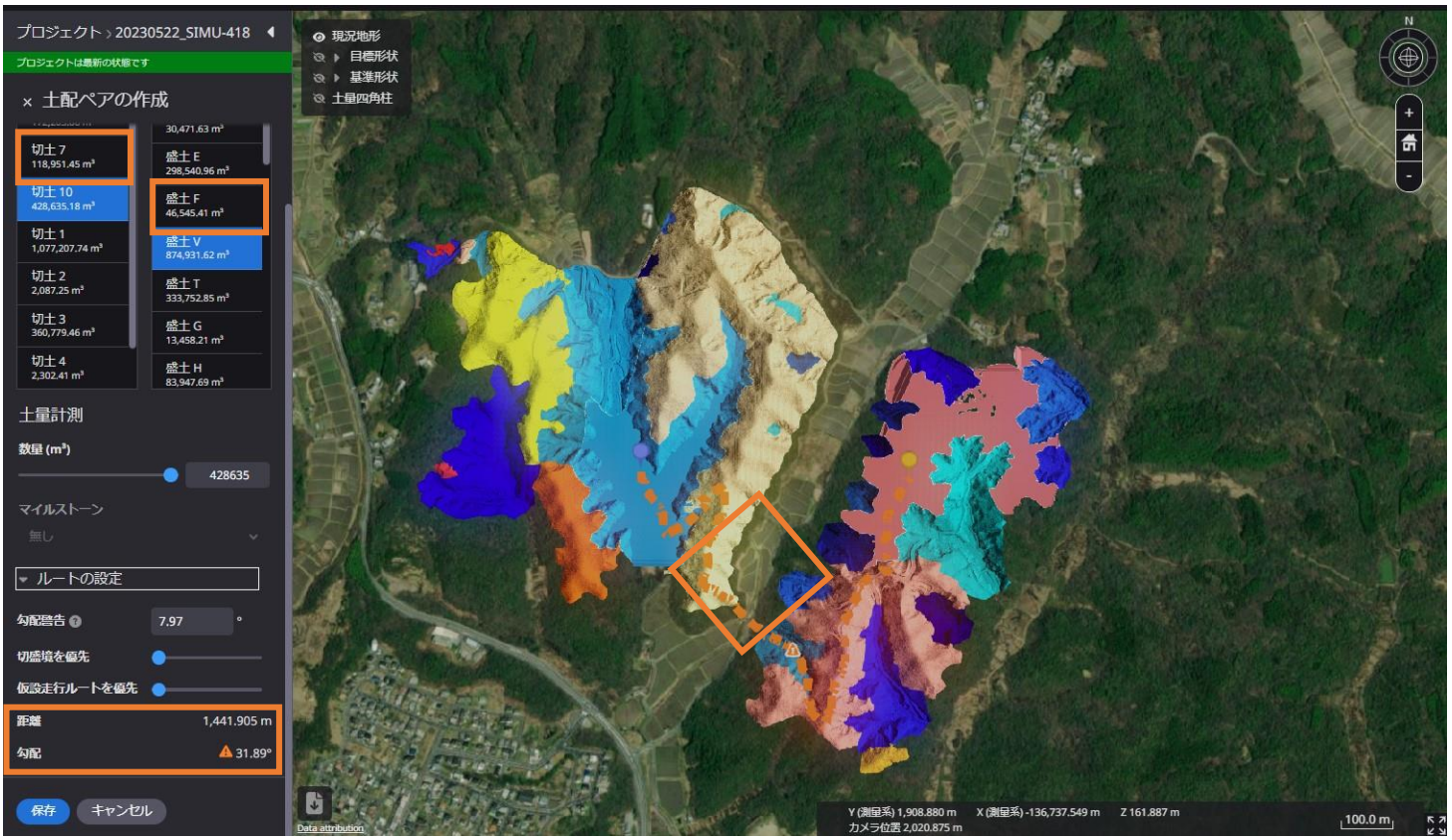
1. No route information is detected if soil distribution pair is created with two distant topographies.



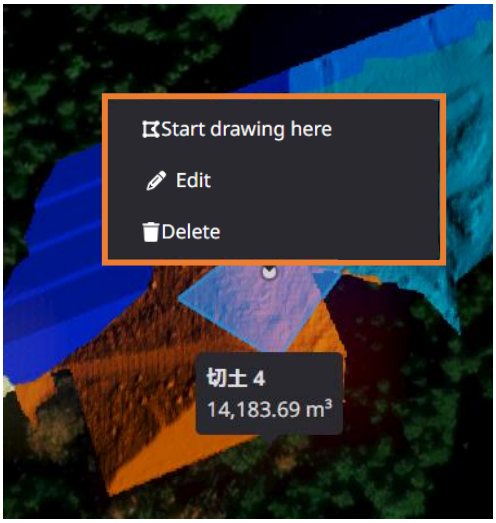
2. Create a travelable area with polygon to detect a route to a remote topography, and press “Save”.



3. If you create a soil distribution pair with two distant topographies, a route that passes over the travelable area will be detected.



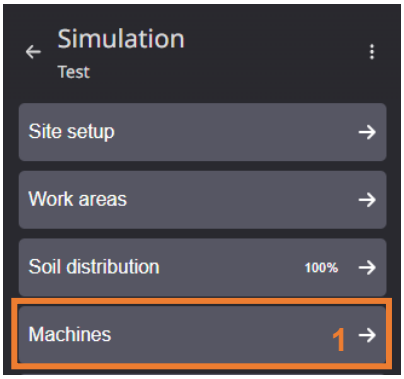
Clicking in the created polygon enables “Start drawing here”, “Edit”, and “Delete”.

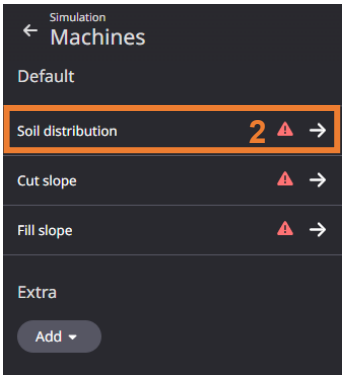


2.1 Setting Up Construction Machine Formation

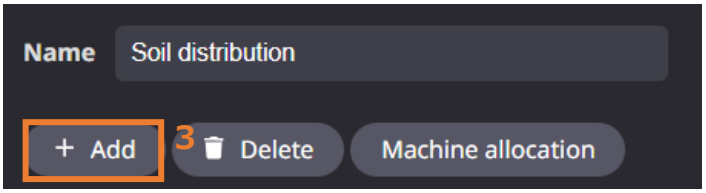
2.1.1 Setting up construction machines and dump trucks to be used for transporting soil

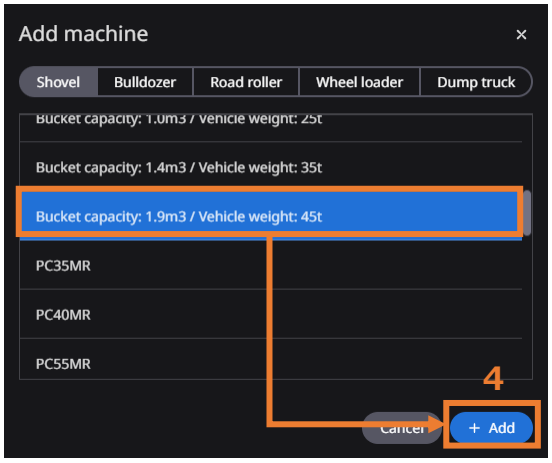
1. Press “Machines”.
2. Press “Soil distribution”.



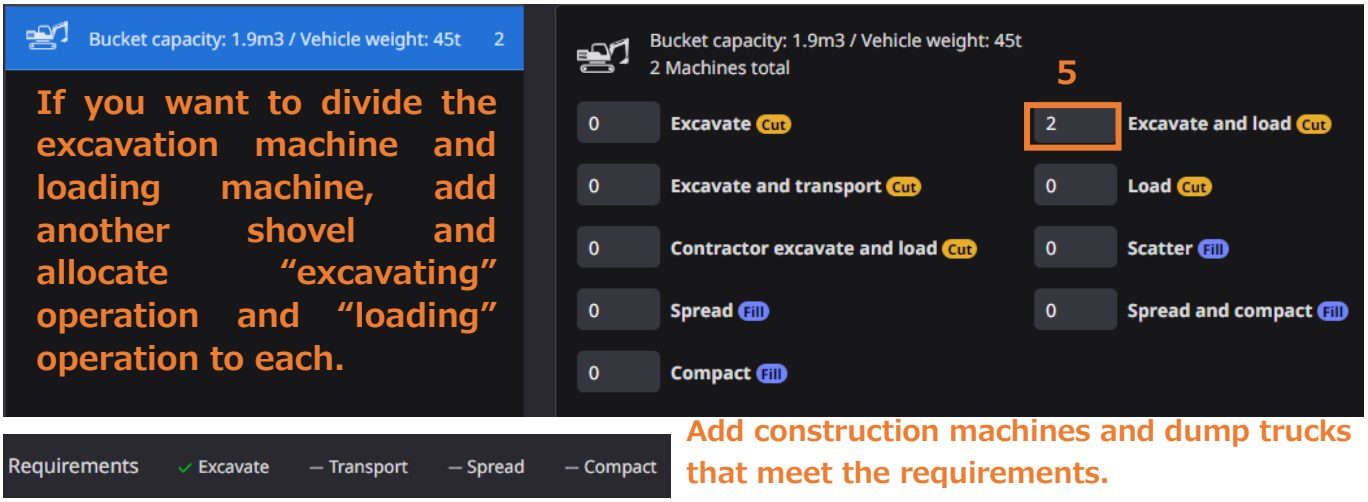


3. Press “Add”.
4. Select the shovel you want to use for excavating and loading operations from the “Shovel” tab, and press “Add”.



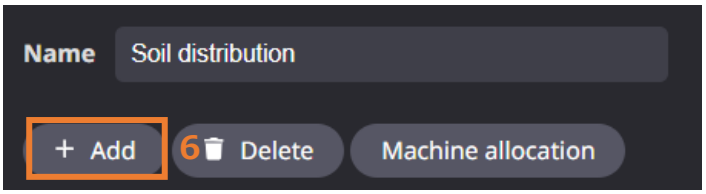


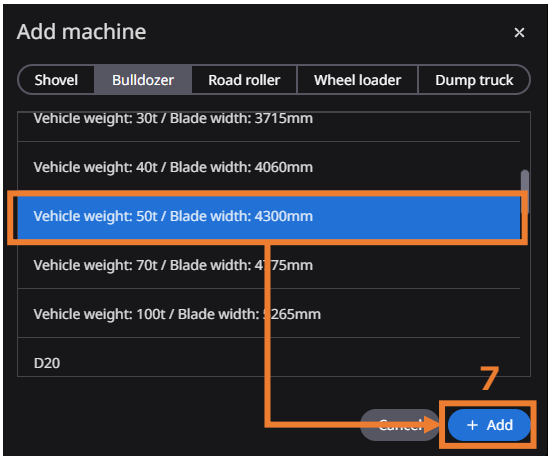
5. Enter the number of machines you want to use in “Excavate and load” section.
   You need to add machines and dump trucks until all the requirement boxes are checked. In this case, the box of “Excavate” is checked. Therefore, you need to check the remaining “Transport”, “Spread” and “Compact”.



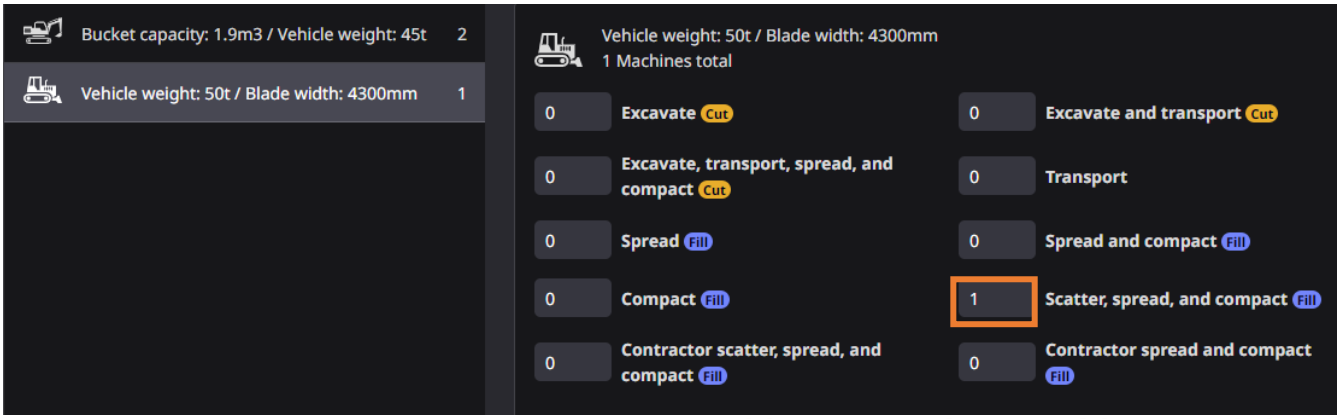
Add construction machines and dump trucks that meet the requirements.

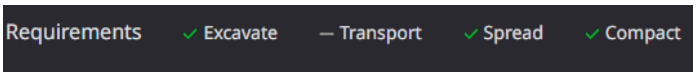
6. Press “Add”.
7. From the “Bulldozer” tab, select the bulldozers you want to use for spreading or compacting operation, and press “Add”.





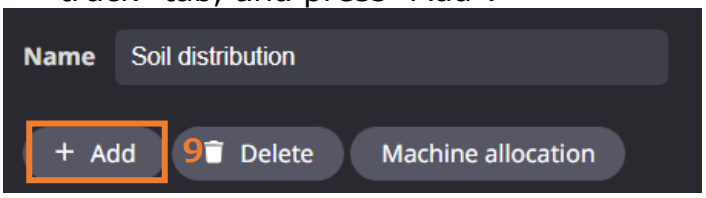
8. Enter the number of machines you want to use in the “Scatter, spread, and compact” section.
   In this case, the boxes of “Spread” and “Compact” are checked. Therefore, you need to check the remaining “Transport”.

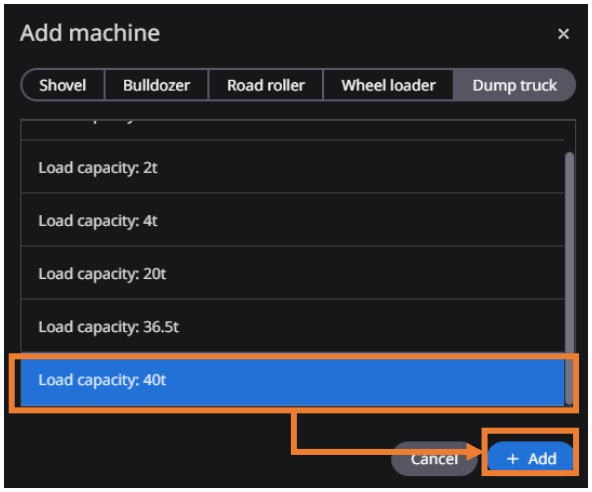




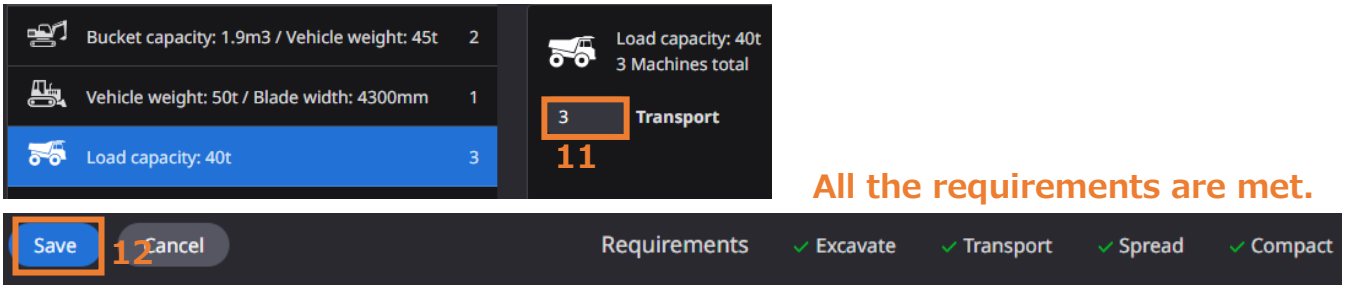
Add construction machines and dump trucks that meet the requirements.

9. Press “Add”.
10. Select the dump truck you want to use for transporting operation from the “Dump truck” tab, and press “Add”.



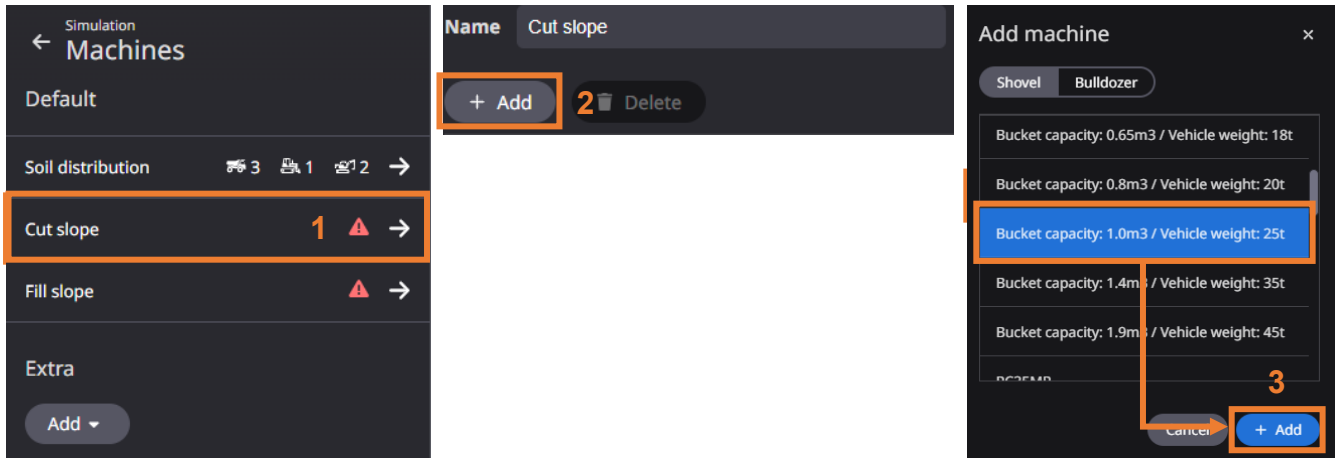


11. Enter the number of machines you want to use in “Transport” section.
    All the requirements are met.
12. Press “Save”.

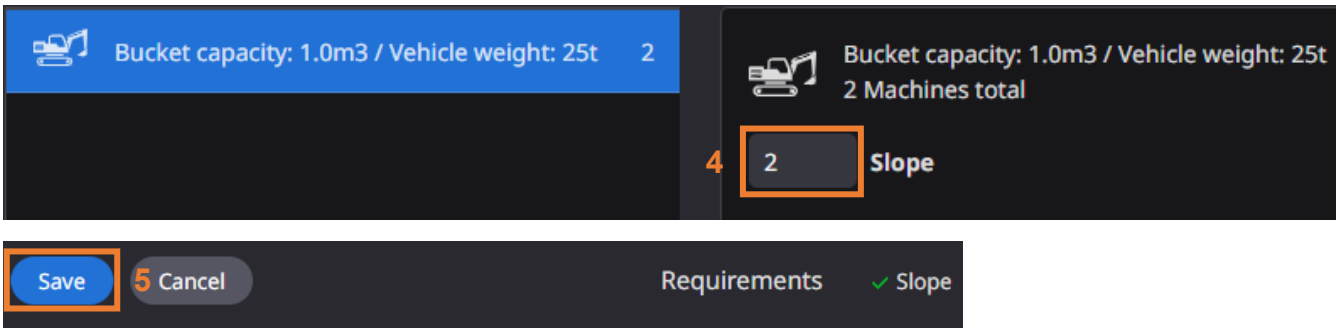


2.1.2 Setting up machines for cutting slope operation

1. Press “Cut slope”.
2. Press “Add”.
3. Select the machines you want to use for cutting slope operations and press “Add”.

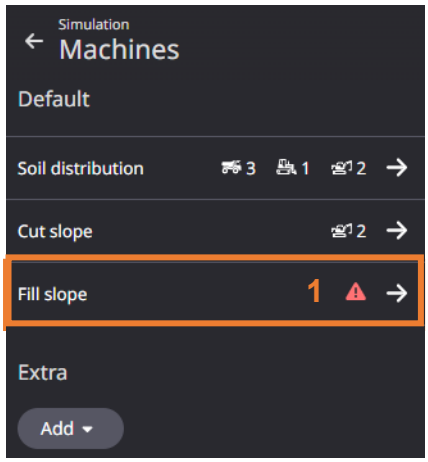


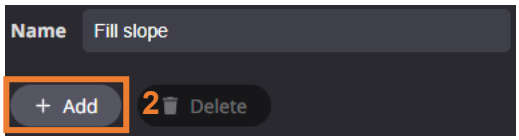
4. Enter the number of machines you want to use in the “Slope” section.
   Requirements are met.
5. Press “Save”.

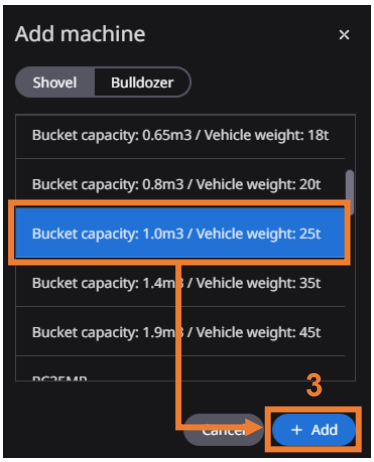


2.1.3 Setting up machines for filling slope operation

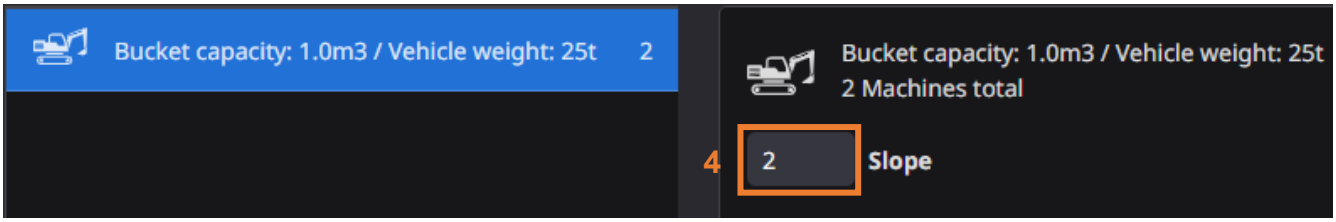
1. Press “Fill slope”.
2. Press “Add”.
3. Select the machines you want to use for filling slope operations and press “Add”.







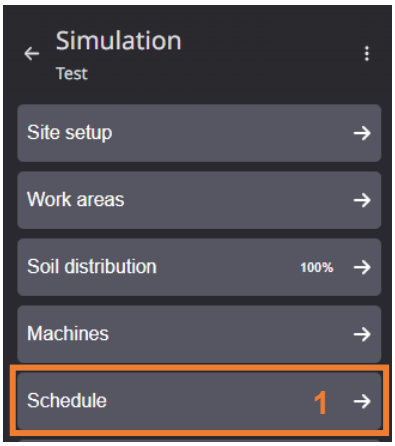
4. Enter the number of machines you want to use in the “Slope” section. Requirements are met.
5. Press “Save”.

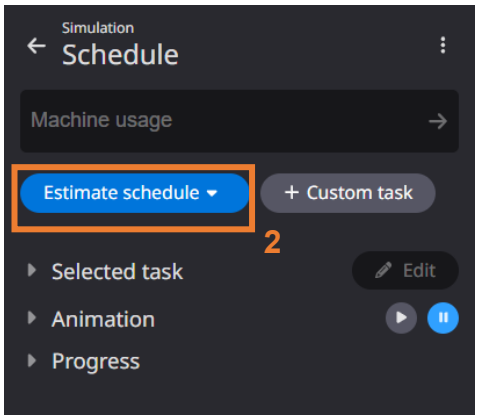


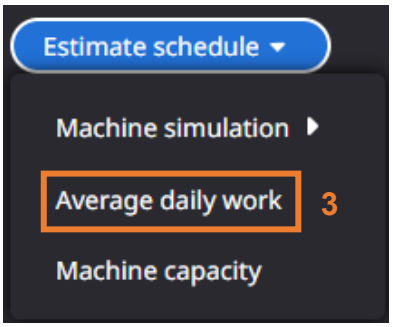
Estimate in a simplified way

2.2.1 Calculating from Amount of Work per Day

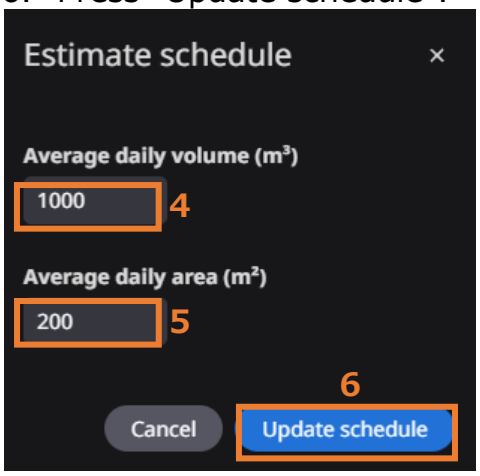
1. Press “Schedule”.
2. Press “Estimate schedule”.
3. Press “Average daily work”.



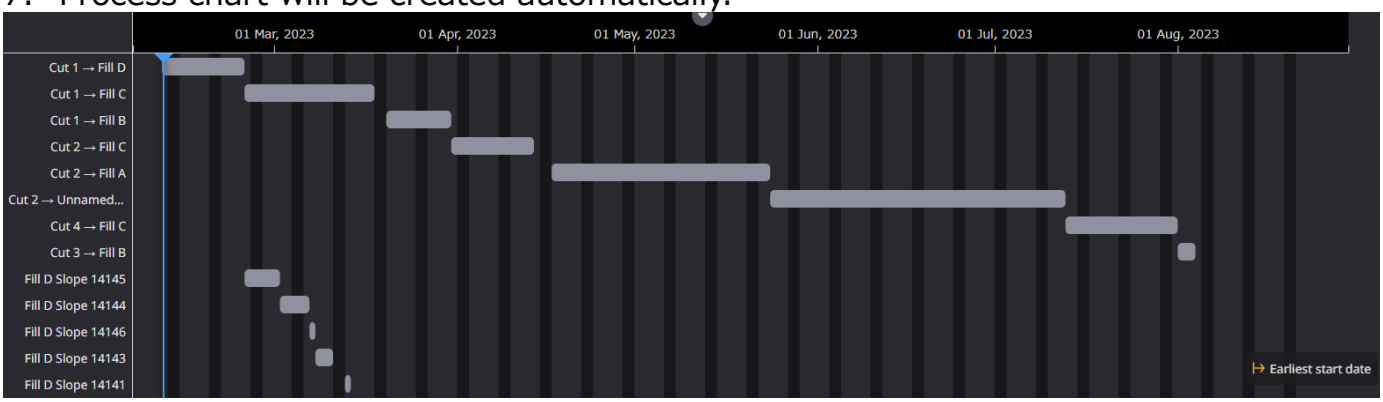




4. Enter the expected soil volume per day in the “Average daily volume (m3)” section.
5. Enter the expected dimensions of slope to be formed per day in the “Average daily area (m2)” section.
6. Press “Update schedule”.

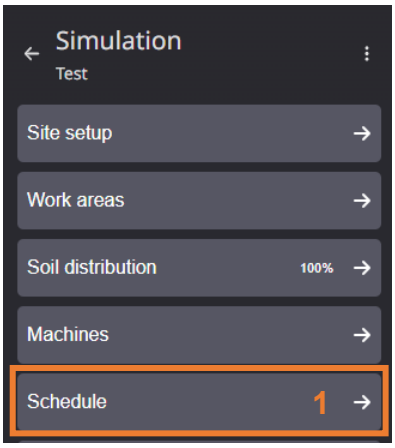


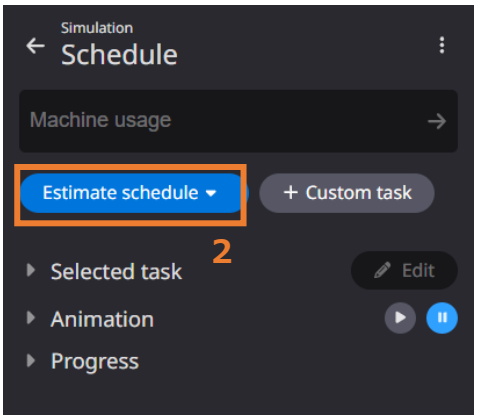
7. Process chart will be created automatically.

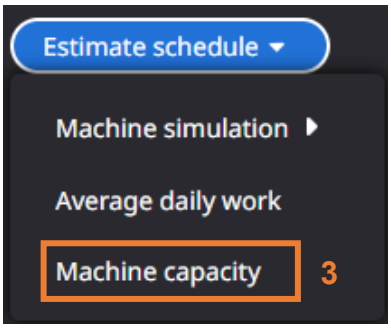


.2.2 Calculating from construction machine operation capacity

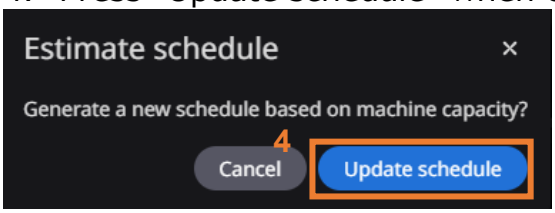
1. Press “Schedule”.
2. Press “Estimate schedule”.
3. Press “Machine capacity”.



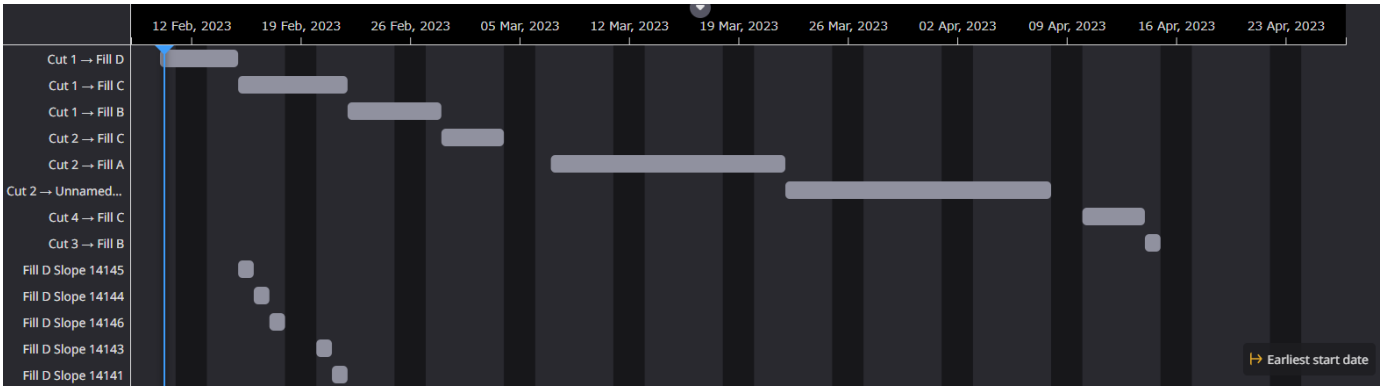




4. Press “Update schedule” when confirmation screen appears.



5. Process chart will be created automatically.

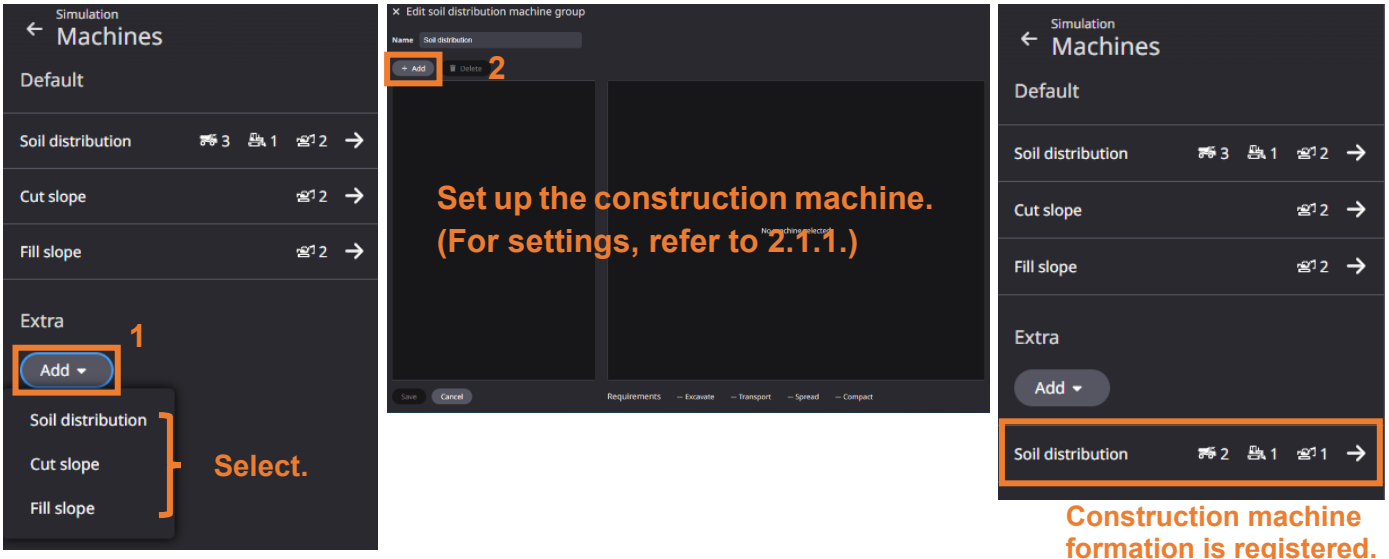


Add construction machine formation / correct process

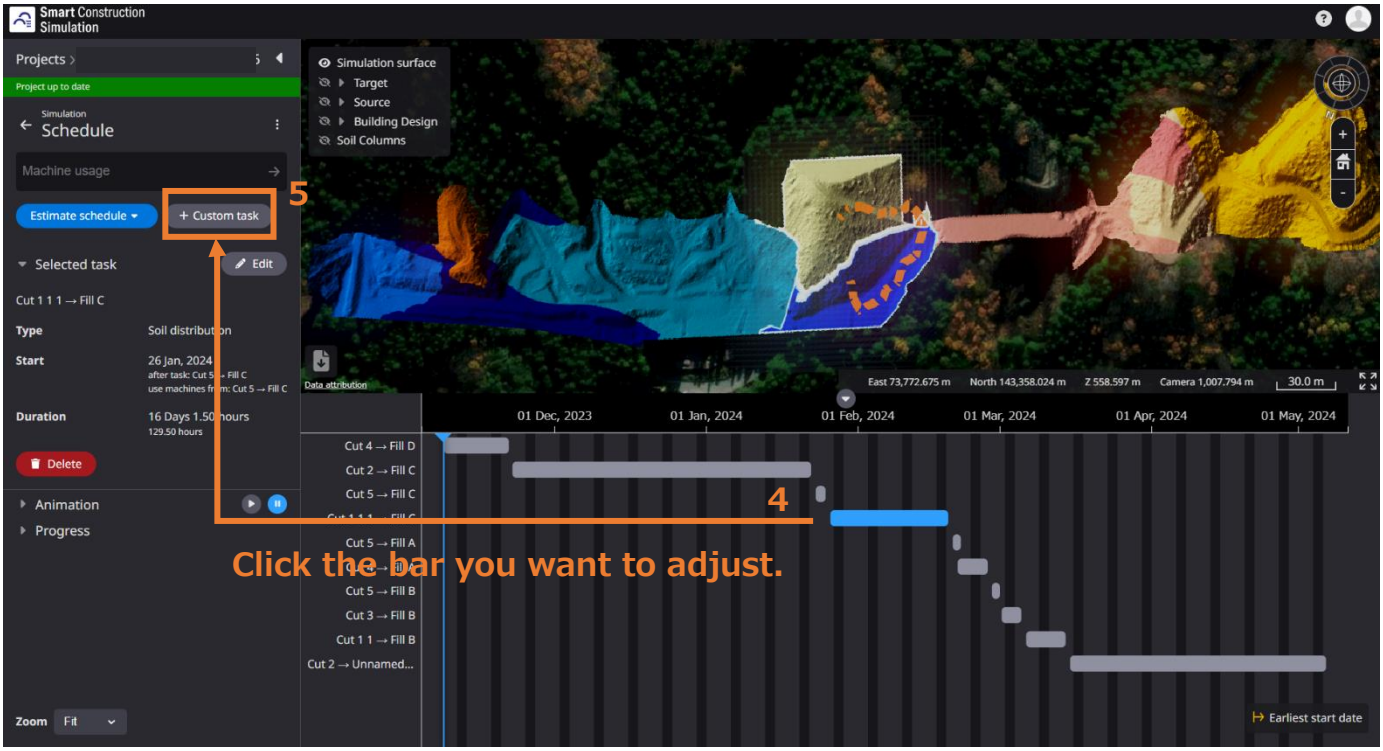
Note

- Use this function to consider a parallel operation and reconsider the operation interval in order to review the processes.
  (*Those settings allow you to examine the construction with multiple teams.)

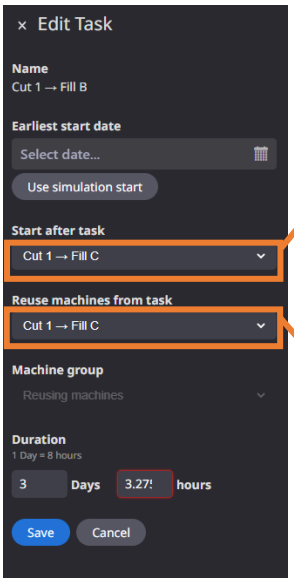
1. Press “Machine”.
2. Press “Add” to set the construction machine to be used.



3. Press “Custom task” to display the process chart.
4. Select the operation you want to review (i.e. operation to be conducted by a construction group set in the above procedure) from the “Process” bar.
5. Selected task. Press the “Edit” button.



6. Set up the timing for starting the task and construction machine formation group to be allocated.

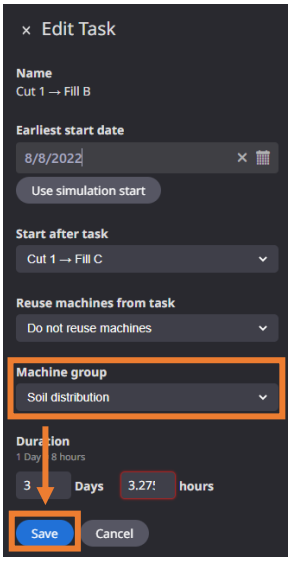


You can edit the previous operation.

▶ If you want to perform it after the existing task:
Select “Corresponding task”.
▶ If you want to perform it without being bound by the existing task:

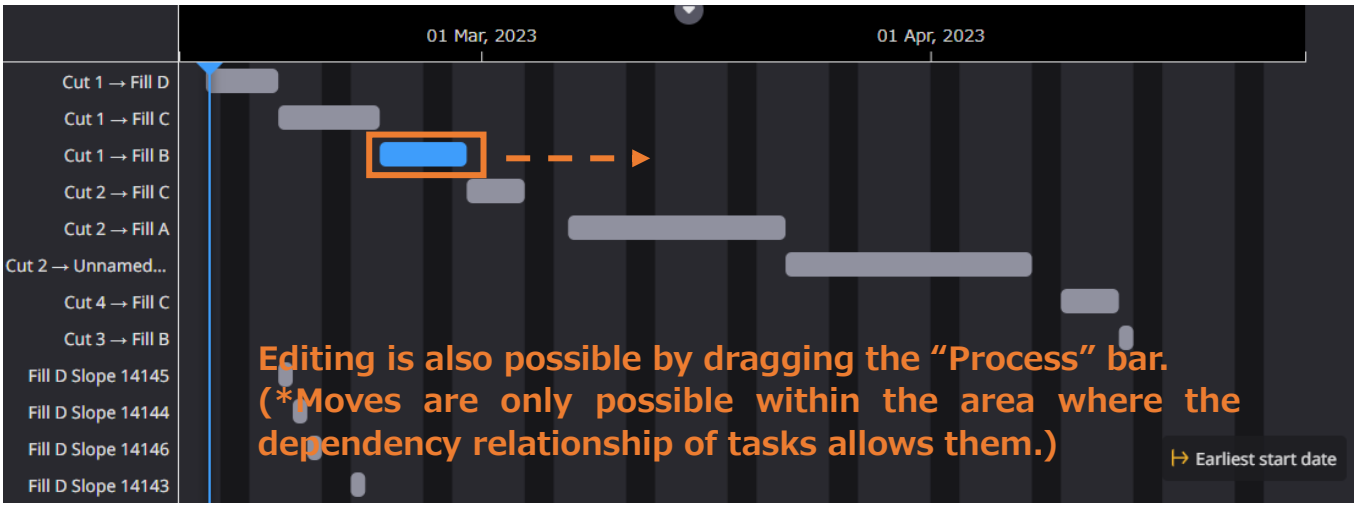
You can edit the takeover construction machine formation.
If you reuse the construction machine from the task that was allocated previously, select “Corresponding task”.
If you want to set up the additional construction machine group that has not been allocated, select “Do not reuse the construction machine”.

7. Set up a construction machine group.



Set up the construction machine group.

8. Process chart is output.

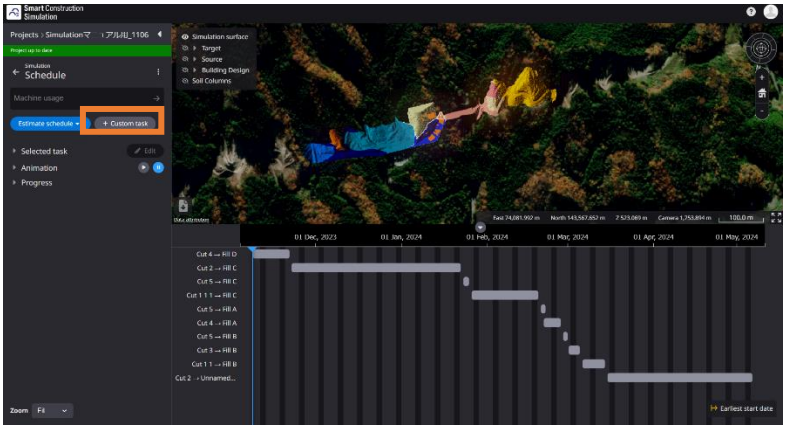


Add optional task

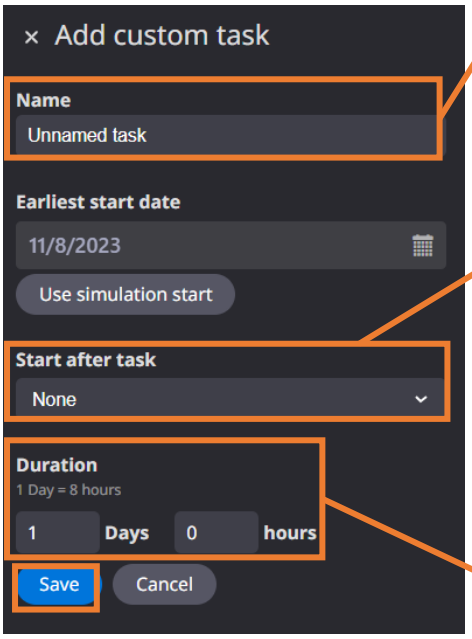
Note

- Use it when you want to optionally incorporate processes from other construction types into the schedule.

1. Press “Custom task”.



2. Set the timing for starting the task and operation.
3. Press “Save”.



You can arbitrarily edit the task name.

You can edit the previous operation.

▶ If you want to perform it after the existing task:
Select “Corresponding task”.
▶ If you want to perform it without being bound by the existing task:
Select “None” -> Set up the earliest date of starting the operation.

You can edit the work hours of the task.

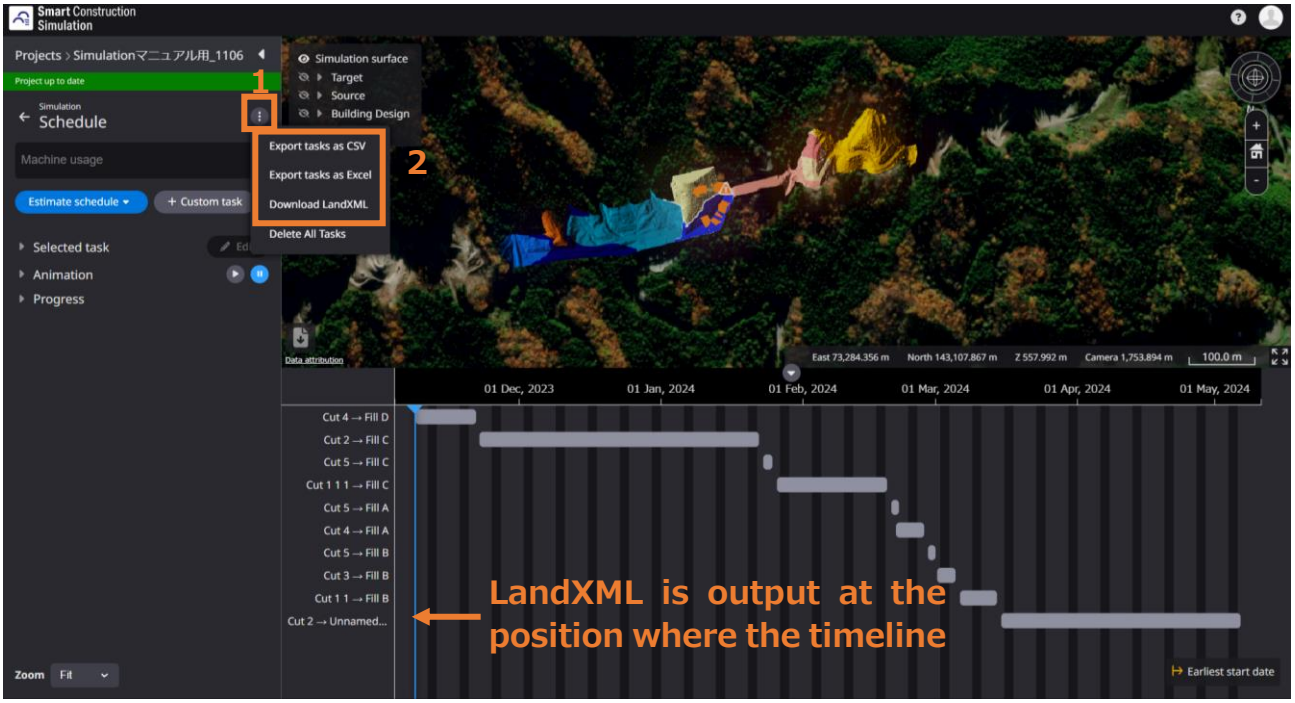
Set work hours in days and per 0.5 hours.

4. The created optional task is added to the process chart.

Process chart output

The created process chart can be exported as a csv file, Excel file, or LandXML file.

1. Press the ellipsis on the right side of the “Process chart (construction plan)”.
2. Select the file type you want to output.
3. It is automatically downloaded.
   *LandXML outputs the LandXML at the position where the timeline bar is located.



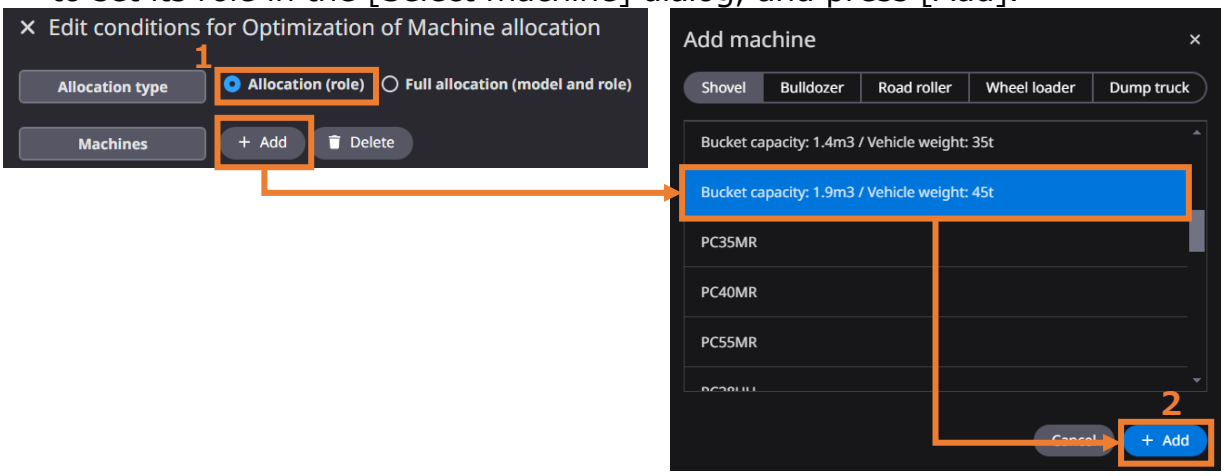
Calculation of appropriate number of construction machines

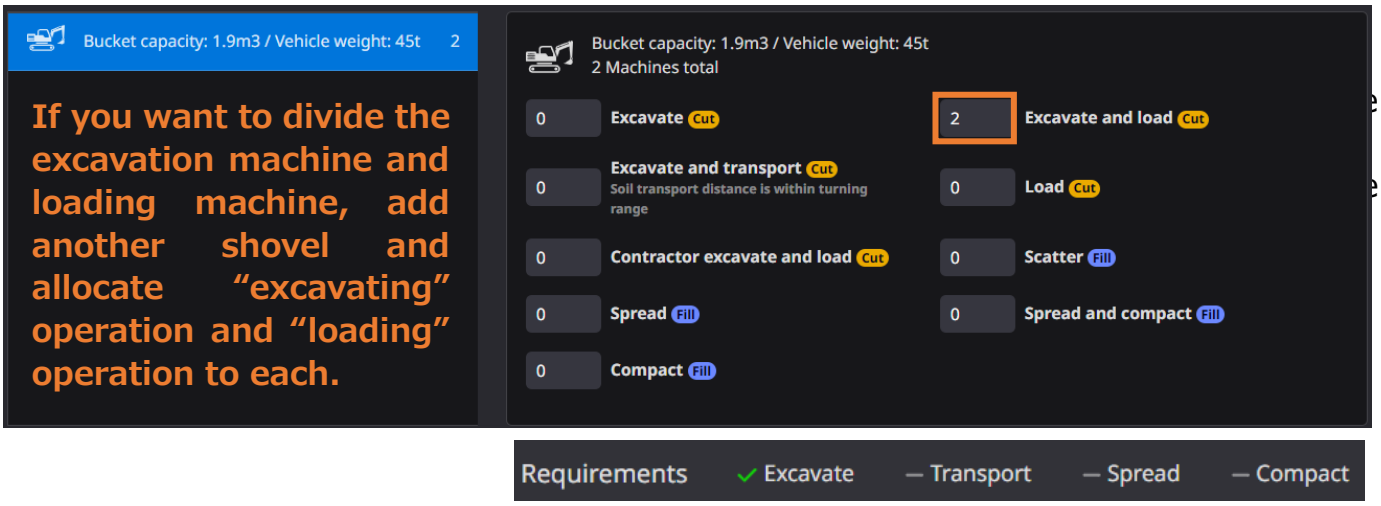
Note

- By using this function, you can calculate the optimum number of construction machines for the delivery date.
  It is also displayed on the graph, allowing you to change the conditions and easily recalculate it.

■ When defining the number of construction machines from the costs and construction period calculated by setting the number of machines in the manual mode and the number of machines in the semi-automatic mode

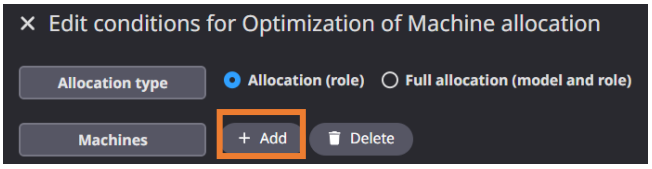
1. In [Edit conditions for Optimization of Machine allocation], select [Allocation(role)] for the type of appropriate vehicle distribution.
2. Press [Add] on the construction machine, select the construction machine you want to set its role in the [Select machine] dialog, and press [Add].

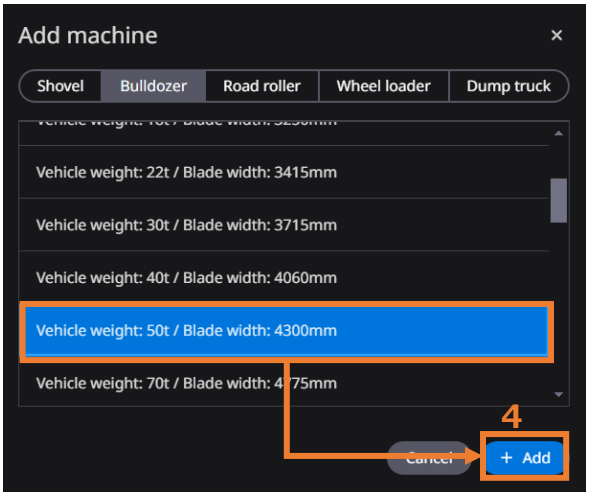




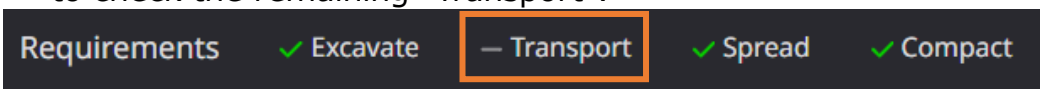
Add construction machines and dump trucks that meet the requirements.

4. Press [Add] on the construction machine, select the construction machine you want to set its role in the machine selection dialog, and press [Add].

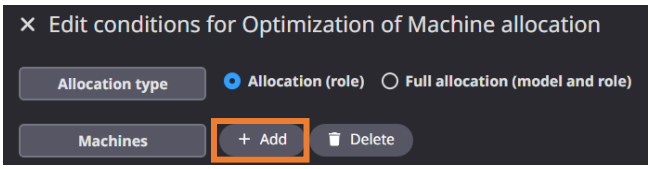


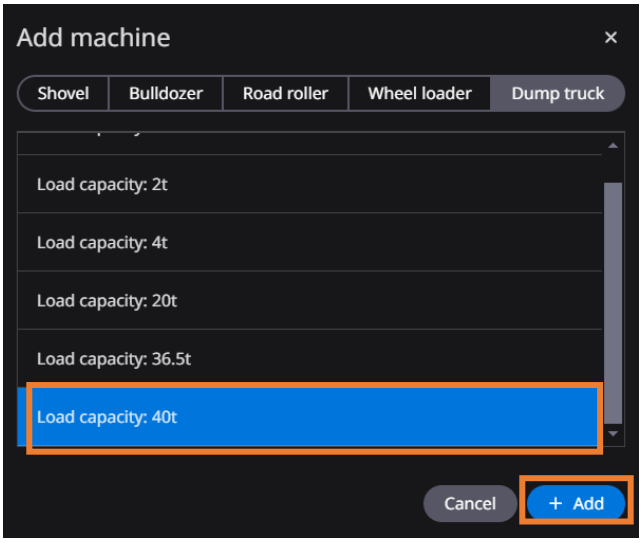


5. Enter the number of machines you want to use in the “Scatter, spread, and compact” section.
   In this case, the boxes of “Spread” and “Compact” are checked. Therefore, you need to check the remaining “Transport”.

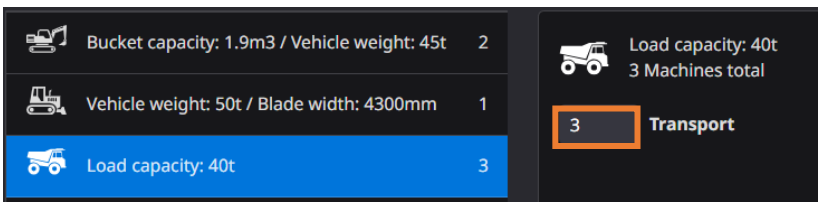


6. Press [Add] on the construction machine, select the construction machine you want to set its role in the construction [Select machine] dialog, and press [Add].

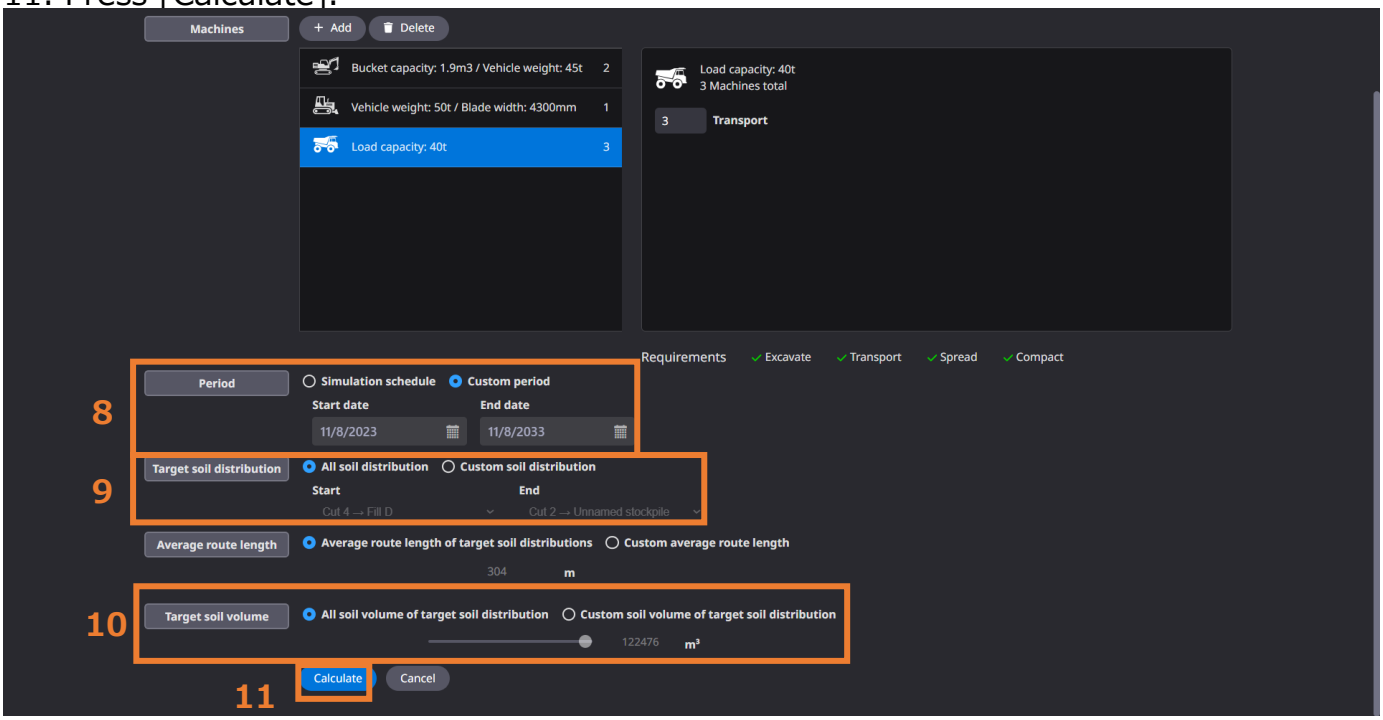




7. Enter the number of machines you want to use in “Transport” section.
   All the requirements are met.



8. Set up the condition for calculating the number of machines [Custom period].
9. Set the condition for calculating the number of machines [All soil distribution].
10. Set the condition for calculating the number of machines [All soil volume of target soil distribution].
11. Press [Calculate].



12. With [Enter number of machines in the manual mode] and [Number of machines calculated according to the conditions], the costs/construction period are calculated and a graph is displayed.

    Click the graph to switch the display.

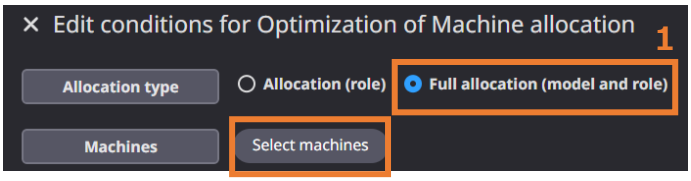
13. Press [Apply selected result], and the number of machines of the selected data is set in the machine group.

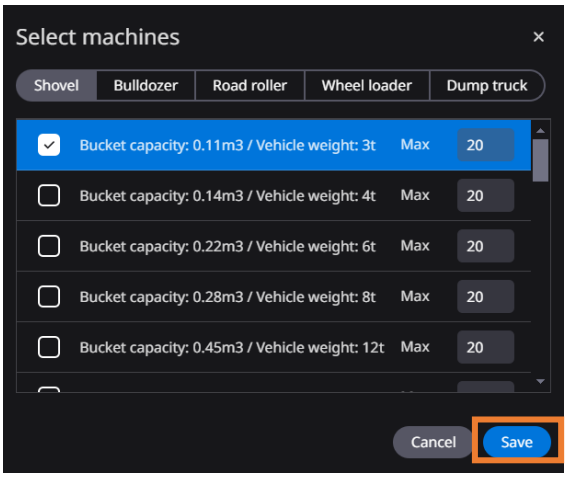
Allocation

Manual

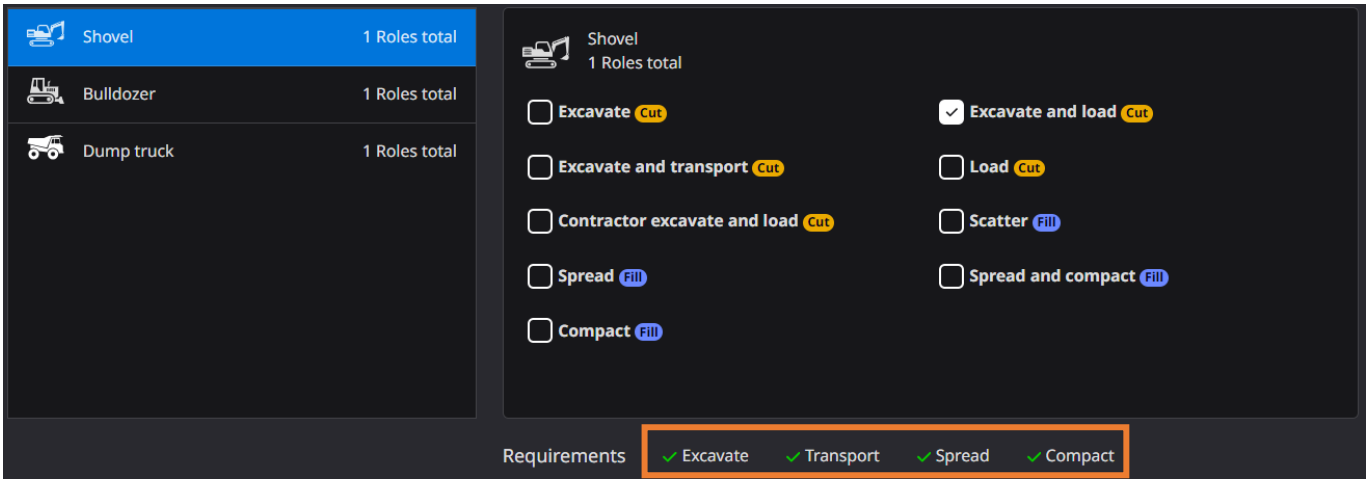
■ When calculating the number of construction machines by simply selecting the construction model and role, and setting the calculation conditions, without entering the number of machines per model/role

1. Select [Full allocation (model and role)] for the type of appropriate vehicle distribution in [Edit conditions for Optimization of Machine allocation].
2. On the construction machine, press [Select machine], check the box on the construction machine you want to set its role from the [Select construction machine] dialog, and press [Save]. *Save when all construction models are selected, not for each construction machine tab.

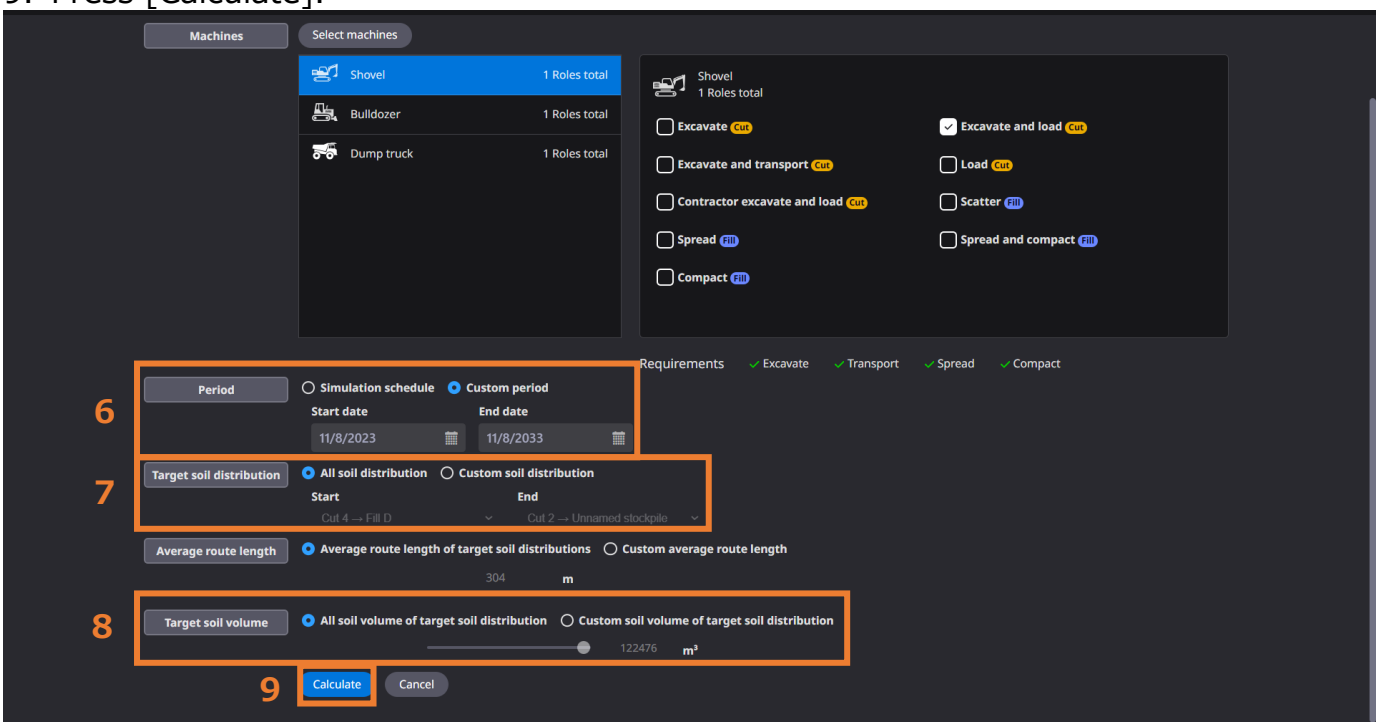




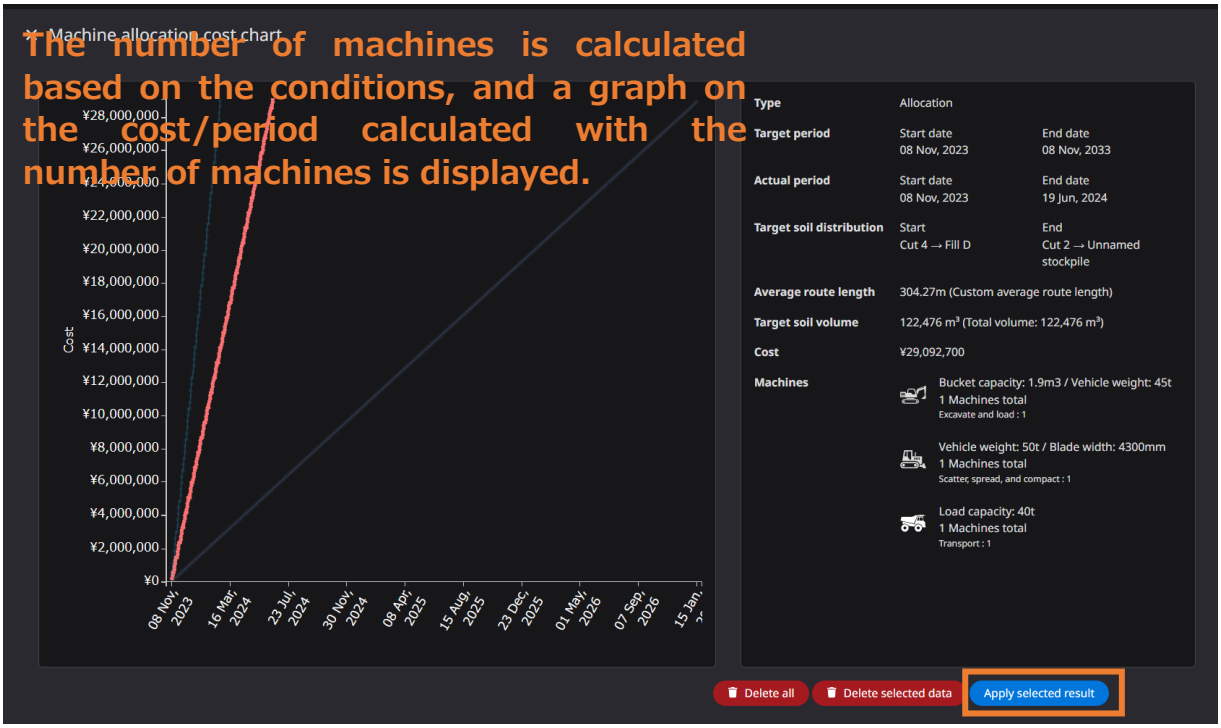
3. Check the box on [Excavate and load] of the excavator.
4. Check the box on [Scatter, spread, and compact] of the bulldozer.
5. If you check the box on [Transport] of the dump truck, all the requirements are met.



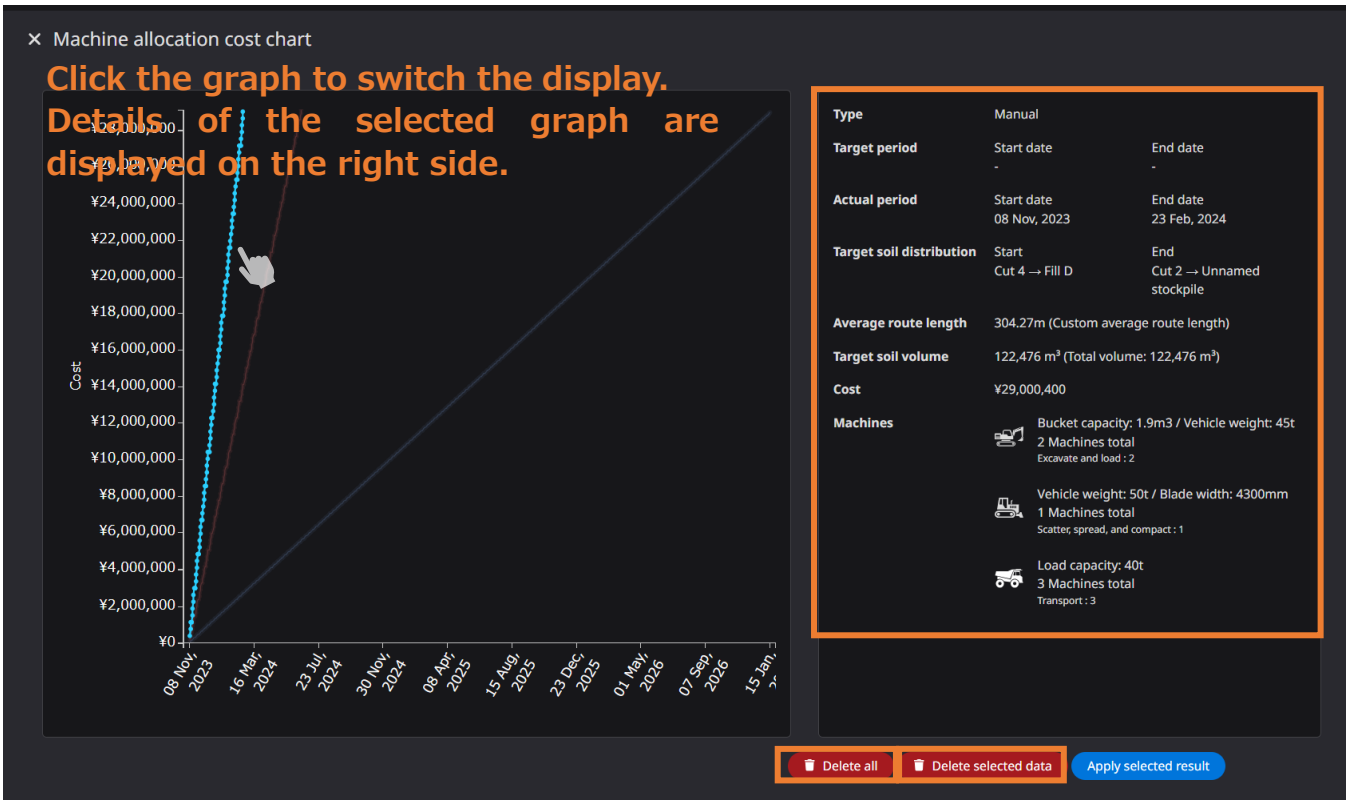
6. Set up the condition for calculating the number of machines [Custom period].
7. Set the condition for calculating the number of machines [All soil distribution].
8. Set up the condition for calculating the number of machines [All soil volume of target soil distribution].
9. Press [Calculate].



10. With [the number of machines calculated according to the conditions], the costs/construction period are calculated and displayed on a graph.
11. Press [Apply selected result]. The number of machines of the selected data is set in the machine group.



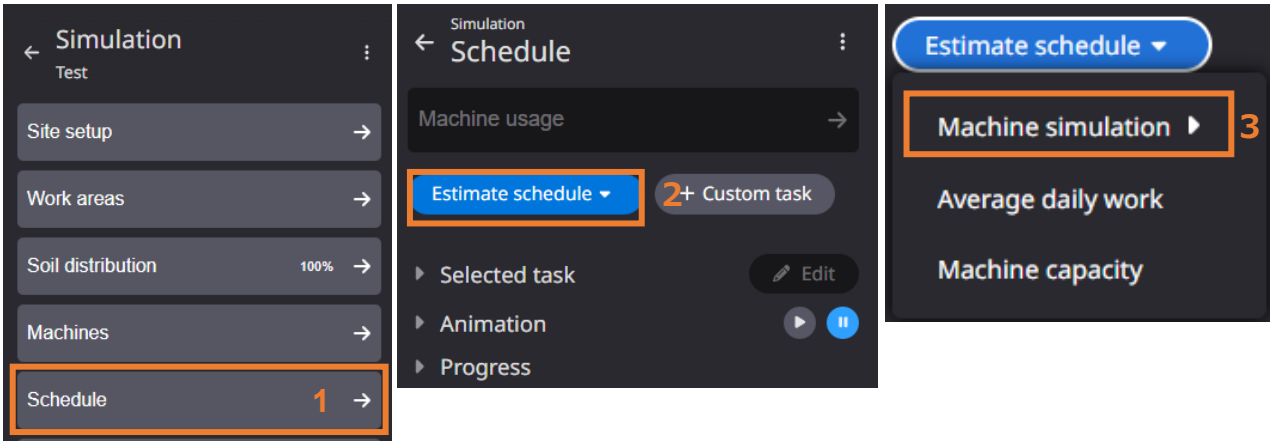
Press [Delete all] or [Delete selected data] to delete the calculation results.



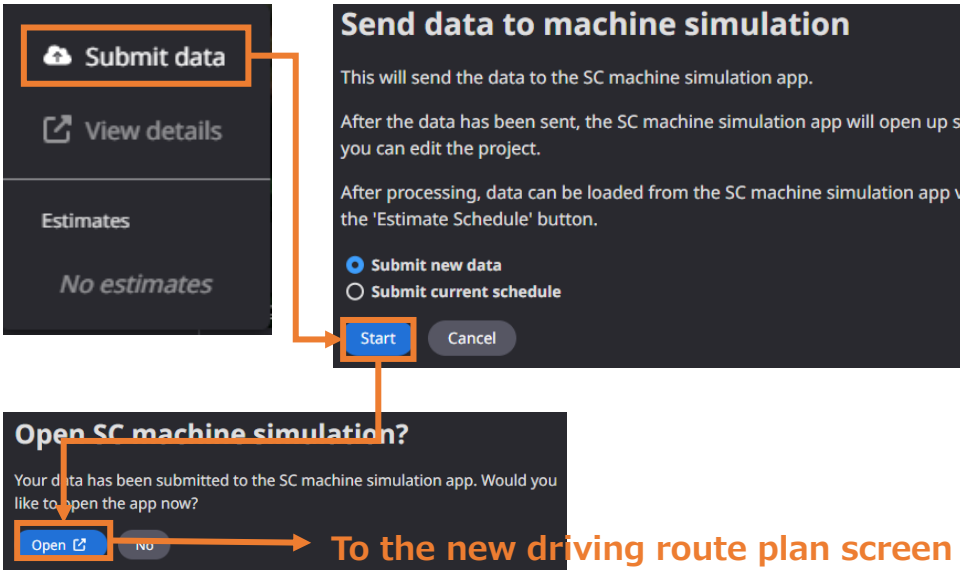
Note

- The calculated vehicle distribution data is not automatically deleted.
  By calculating under various conditions, you can draw up an optimum construction plan.

1. Press “Schedule”.
2. Press “Estimate schedule”.
3. Press “Machine simulation”.



4. Press “Submit data”.
5. Select one of them and press “Start”.
   It brings you to the machine simulation. A new plan is automatically added and linked with the data.



New plan is added separately.

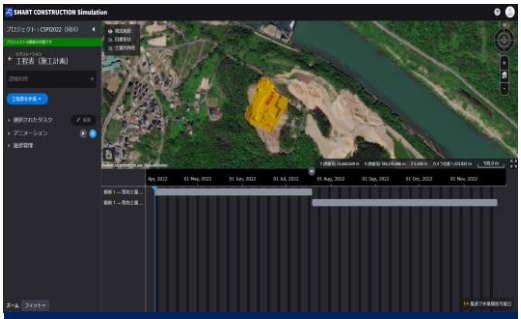
function description

“Submit new data”
→ Used to coordinate work schedules created from Average daily work and machine capacity.

“Submit current schedule”
→ Used when edit a task in the process chart

(Reference) Relationship between soil distribution simulation and machine simulation

Soil simulation



Features

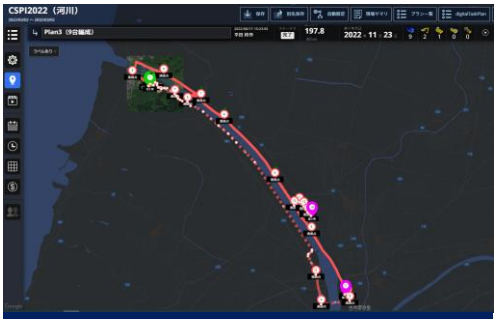
Calculation with ideal machine (work) resources

Federate Data

Data connectivity

Reflect Creation Data

construction machine simulation



Features

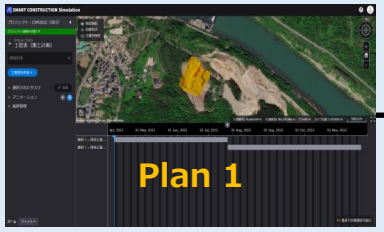
Machine operation can be simulated in detail.
(Based on each condition, it is possible to examine)

When to use??

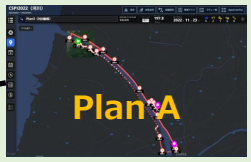
- When determining the machine organization in consideration of carrying-in and carrying-out outside the field
- When reflecting various conditions related to machine operation
  (single-sided traffic, road surface conditions, temporary mud storage site, traffic lights etc.)
- When you want to check the operation status of multiple machines
  (retention of dump, etc.)

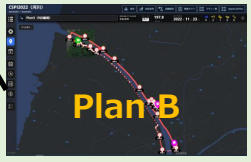
■ Linkage with data

Soil simulation



construction machine simulation



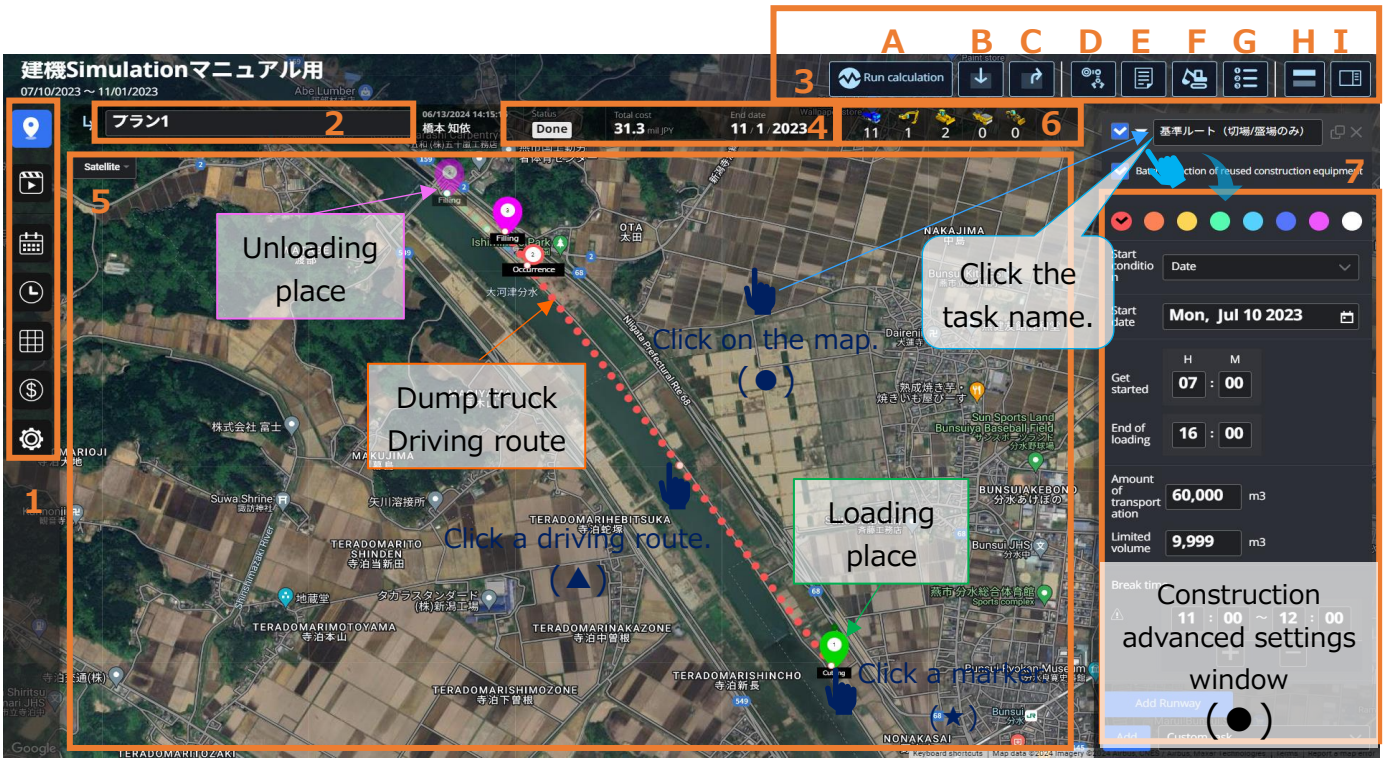


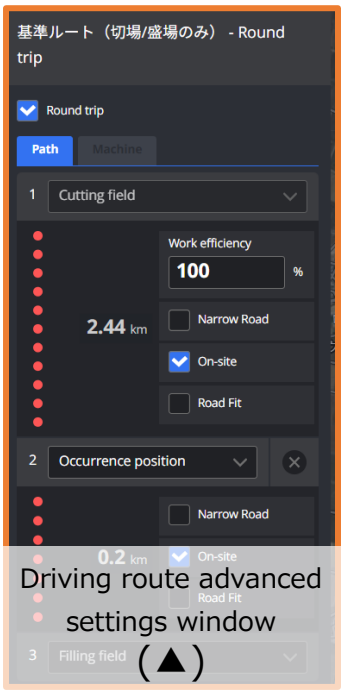
Based on a single soil simulation, the construction machine simulation can compare multiple plans.

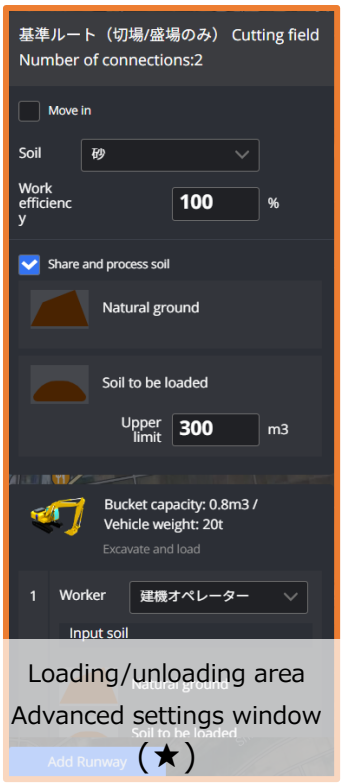
Attention

From Soil Simulation Side
when transferring data to the construction machine simulation side
We have verified the consistency of both basic data.
If the data is inconsistent, an error is printed.
(When Machine Information File, etc., is Changed on Only One Side)
must match the information on both sides.)

3.1 Explanation of Construction Machine Operation Simulation Home Screen





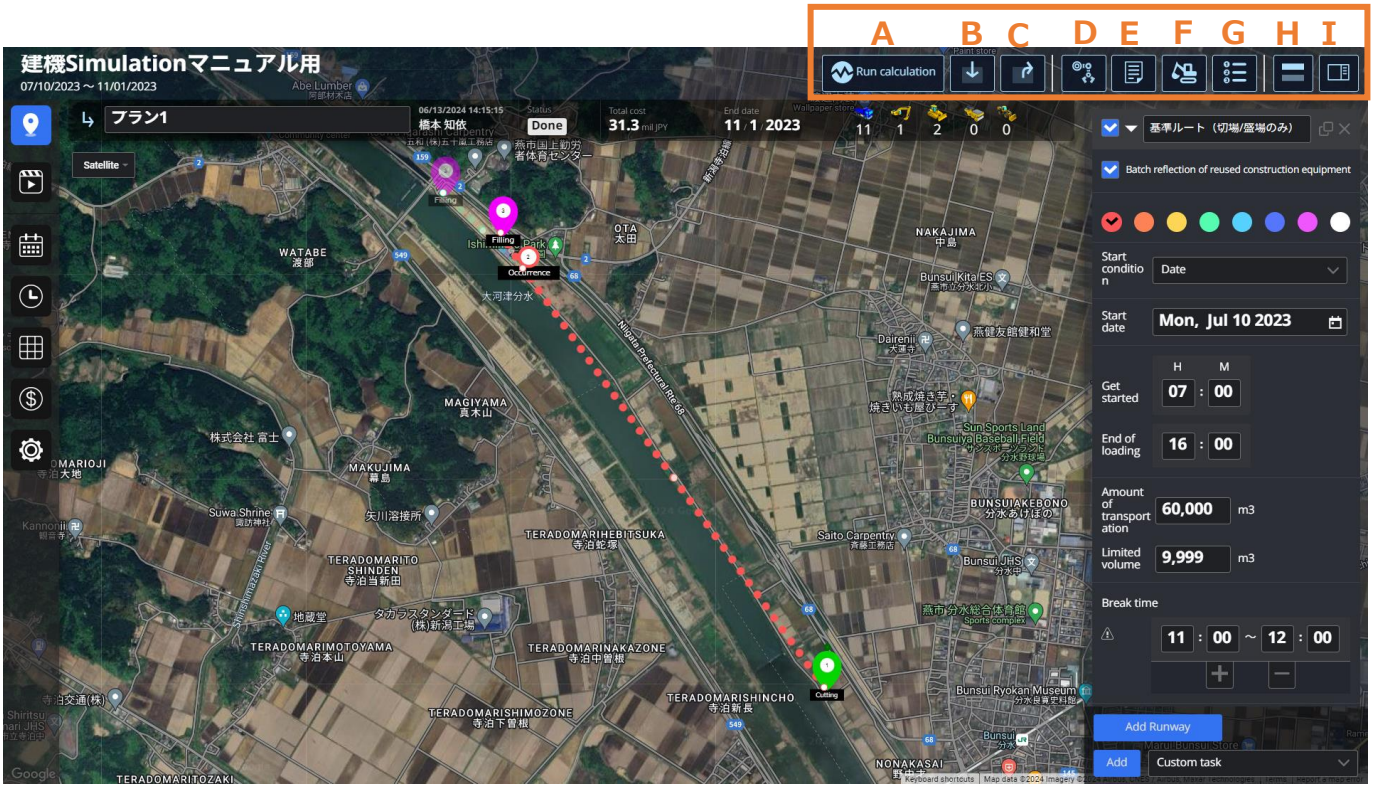


1. If you select each icon after executing a simulation calculation, the screen switches to the one that shows the results of the process, machine operating rate, costs, etc.
2. Name of the plan that is being loaded is displayed.

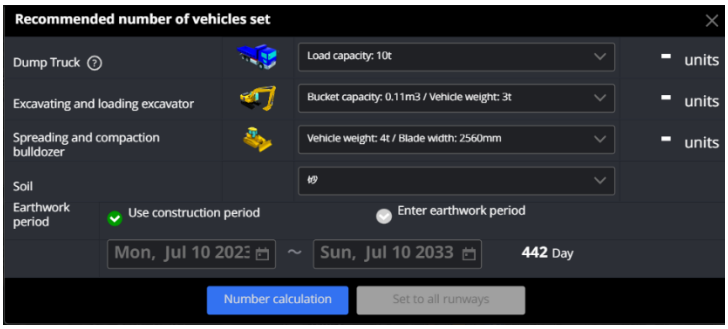
3. A. Run calculation: To execute a simulation calculation after completing each setting.
   B. Save: To save under the current plan name.
   C. Save as: To change the plan name and save the copy.
   D. Auto setting: Recommended number of machines can be set by selecting the construction period and machine.
   E. Summary: Basic work capacity of each work machine can be checked.
   F. Basic Info: To check the basic information of each construction machine such as coefficient that serves as the ground for calculation.
   G. Plans: To display a list of saved plans.
   H. To confirm the current account and change the language.
   I. To show or hide the construction advanced settings window
4. Costs and ending date of construction are displayed after executing the simulation calculation.
5. Driving route, loading area, and unloading area markers of each step set in the previous section are displayed.
6. The current total number of construction machines is displayed.
7. Perform advanced settings and changes of construction procedures, driving route, loading/unloading area.
   You can switch it by clicking the target on the map.

■ Introduction of machine simulation functions (details of section 3 on the previous page)

*Detailed functions are introduced.



▶ D. “Recommended machine formation” functions



[What you can do]

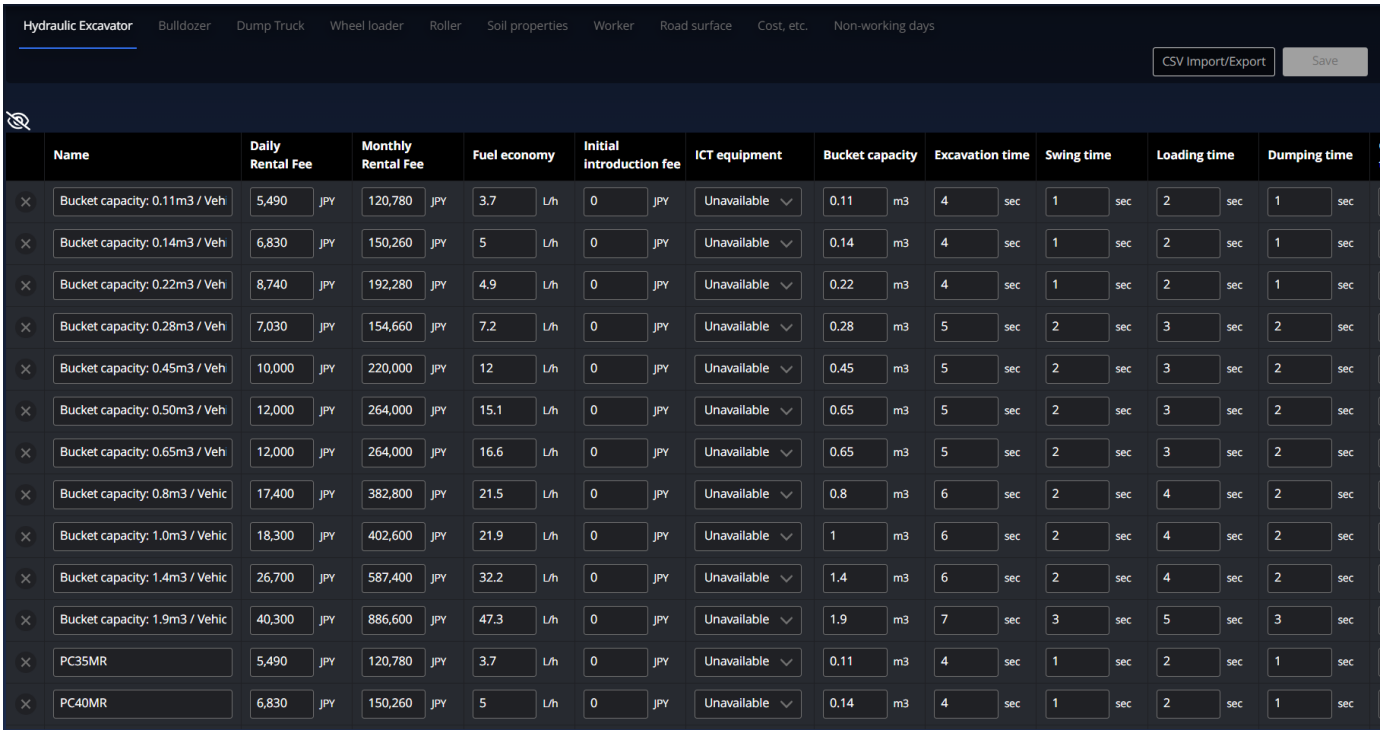
・ Calculation of the recommended number of machines based on the construction period

*Type of machine must be specified.

▶ E. “Working capacity of selected machine” function

[What you can do]
Calculation results (ground) of each construction machine can be checked, and the basic data tables used can also be checked.

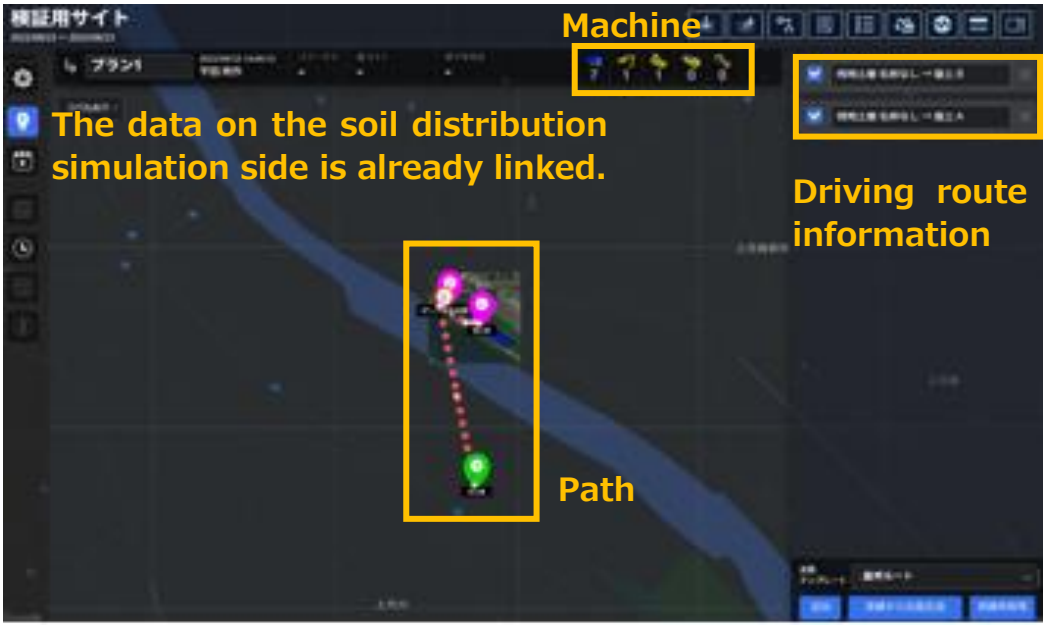
▶ F. “Basic data” function



Name	Daily Rental Fee	Monthly Rental Fee	Fuel economy	Initial introduction fee	ICT equipment	Bucket capacity	Excavation time	Swing time	Loading time	Dumping time
Bucket capacity: 0.11m3 / Veh	5,490 JPY	120,780 JPY	3.7 L/h	0 JPY	Unavailable	0.11 m3	4 sec	1 sec	2 sec	1 sec
Bucket capacity: 0.14m3 / Veh	6,830 JPY	150,260 JPY	5 L/h	0 JPY	Unavailable	0.14 m3	4 sec	1 sec	2 sec	1 sec
Bucket capacity: 0.22m3 / Veh	8,740 JPY	192,280 JPY	4.9 L/h	0 JPY	Unavailable	0.22 m3	4 sec	1 sec	2 sec	1 sec
Bucket capacity: 0.28m3 / Veh	7,030 JPY	154,660 JPY	7.2 L/h	0 JPY	Unavailable	0.28 m3	5 sec	2 sec	3 sec	2 sec
Bucket capacity: 0.45m3 / Veh	10,000 JPY	220,000 JPY	12 L/h	0 JPY	Unavailable	0.45 m3	5 sec	2 sec	3 sec	2 sec
Bucket capacity: 0.50m3 / Veh	12,000 JPY	264,000 JPY	15.1 L/h	0 JPY	Unavailable	0.65 m3	5 sec	2 sec	3 sec	2 sec
Bucket capacity: 0.65m3 / Veh	12,000 JPY	264,000 JPY	16.6 L/h	0 JPY	Unavailable	0.65 m3	5 sec	2 sec	3 sec	2 sec
Bucket capacity: 0.8m3 / Vehic	17,400 JPY	382,800 JPY	21.5 L/h	0 JPY	Unavailable	0.8 m3	6 sec	2 sec	4 sec	2 sec
Bucket capacity: 1.0m3 / Vehic	18,300 JPY	402,600 JPY	21.9 L/h	0 JPY	Unavailable	1 m3	6 sec	2 sec	4 sec	2 sec
Bucket capacity: 1.4m3 / Vehic	26,700 JPY	587,400 JPY	32.2 L/h	0 JPY	Unavailable	1.4 m3	6 sec	2 sec	4 sec	2 sec
Bucket capacity: 1.9m3 / Vehic	40,300 JPY	886,600 JPY	47.3 L/h	0 JPY	Unavailable	1.9 m3	7 sec	3 sec	5 sec	3 sec
PC35MR	5,490 JPY	120,780 JPY	3.7 L/h	0 JPY	Unavailable	0.11 m3	4 sec	1 sec	2 sec	1 sec
PC40MR	6,830 JPY	150,260 JPY	5 L/h	0 JPY	Unavailable	0.14 m3	4 sec	1 sec	2 sec	1 sec

[What you can do]
You can check and change the basic data of each construction machine such as coefficient that serves as the ground for calculation.
You can customize it depending on the jobsite and each company.
*By utilizing the “Save” ->”CSV import/export” function in the upper right, the created basic data tables can be used even in other Simulation sites.

[Reference] When data is linked from the



Since the data is already linked to the simulation side, you can set up constraints, edit the route, and review the number of construction machines based on the linked data.

▶ Recommended procedures
(0) Save a plan: Create a plan by “Save as”.
(1) Set a soil-discarding area
(See procedures in 3.5.1.)
(2) Calculation execution
(See procedures in 3.5.2.)
(3) Confirmation of results
(See procedures in 3.6.)
(4) Setting of constraints and conditions
(See procedures from 3.2. through 3.5.)
(5) Confirmation of results
(6) Transfer to soil distribution simulation
(See procedures in 3.7.)

Attention

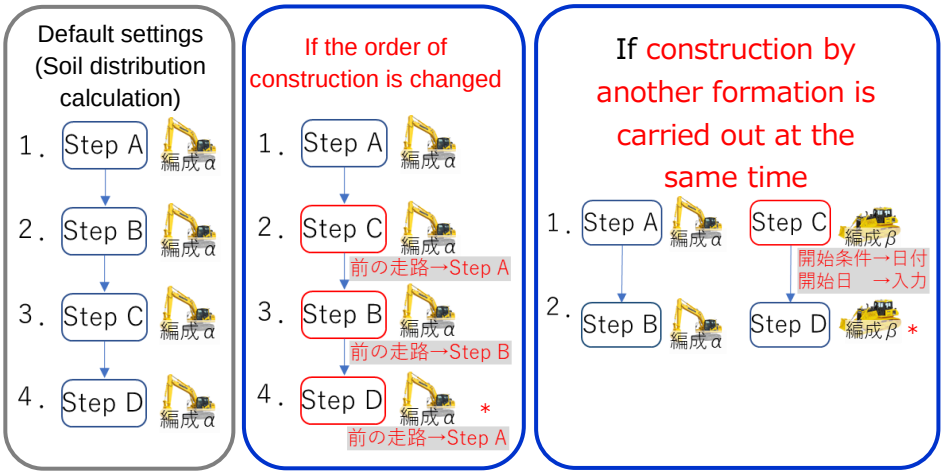
Please save the plan before performing calculation.
Plan 1 should not have completed the calculation run.

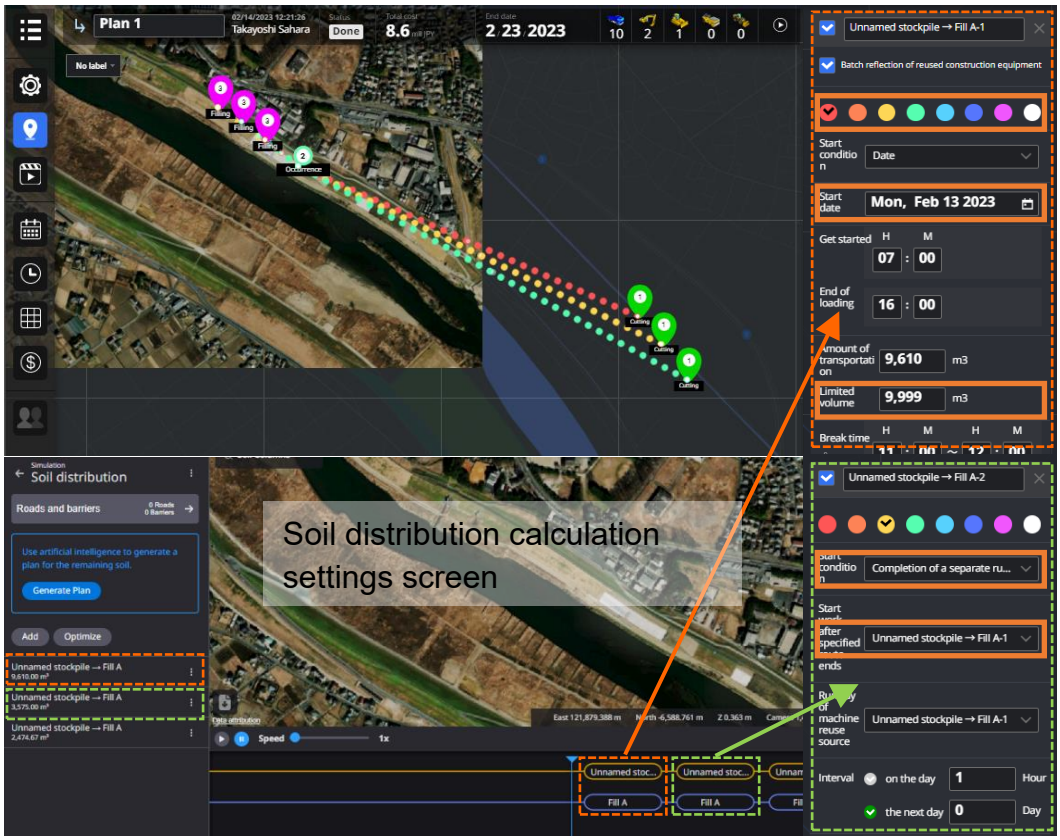
If Plan 1 is running, errors may occur when coordinating with the Soil Distribution Simulation.

3.2 Changing the start date and procedures of operation

At the right end of the screen, information window of each step set in the soil distribution calculation in the previous section is displayed.
Information window of the next step can be checked in the vertical scroll operation.

1. Color can be changed in each step (editing operations such as correction of driving route becomes easier).
2. Change the start date of construction.
3. Fill in if there is a limit in the soil volume to be transported per day.
4. Enter the conditions for starting the step (order in the initial state is that set by the soil distribution calculation).





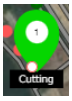
Attention

If you change the break times, please also change the break times in the soil distribution simulation to ensure no discrepancies.

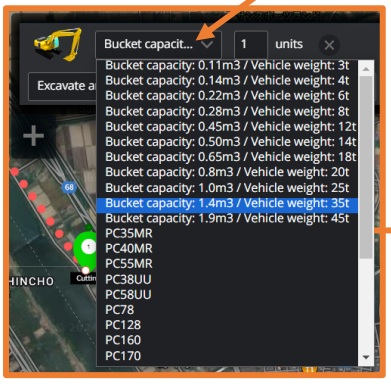
Check the construction machine formation and reset it.

3.3.1 Settings for construction machines in cut areas

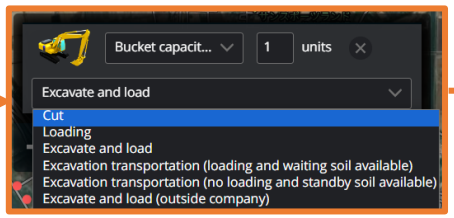
1. Construction machine type set in the previous step is displayed by clicking the marker. If there is no display of construction machine or you want to add one, click the construction machine icon and select the roles of the construction machine and operation again.
2. If the construction machine in the loading area is managed by other company, check the box of it.
   If you check the box, it is excluded from the costs to be posted.
3. Select the soil property that is similar to that of the jobsite.
   Coefficient used for calculation changes (it can be changed from the “Soil property” tab of the “Basic data” button on the home screen).
4. Make adjustments if the normal operational efficiency cannot be secured due to the jobsite environment, etc.
5. Soil volume to be left in the step due to the construction reason can be set.
   Remaining soil volume is handled together in the next step.

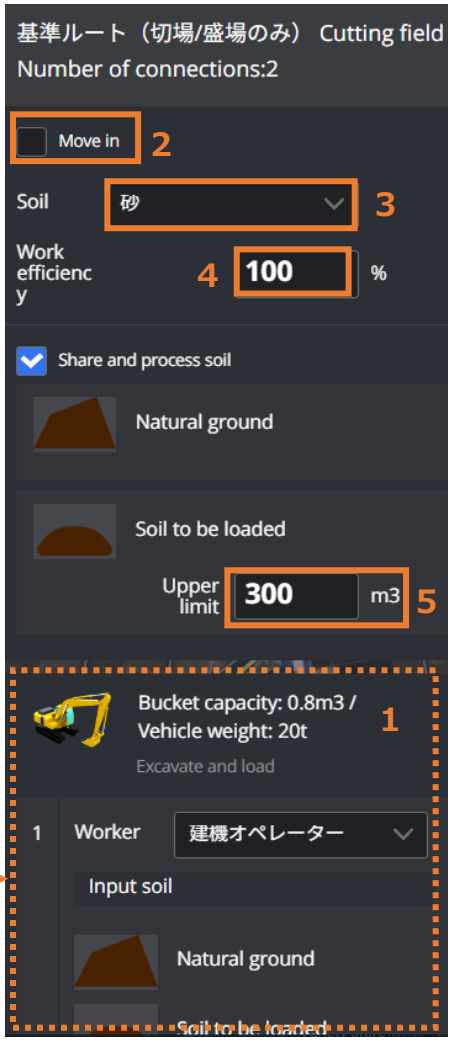


Settings for construction machines in the loading area



If marker overlaps,
set them up while slightly moving each of them.





Settings for construction machines in the fill area

1 Construction machine type set in the previous step is displayed by clicking the marker. If there is no display of construction machine or you want to add one, click the construction machine icon and select the roles of the construction machine and operation again.

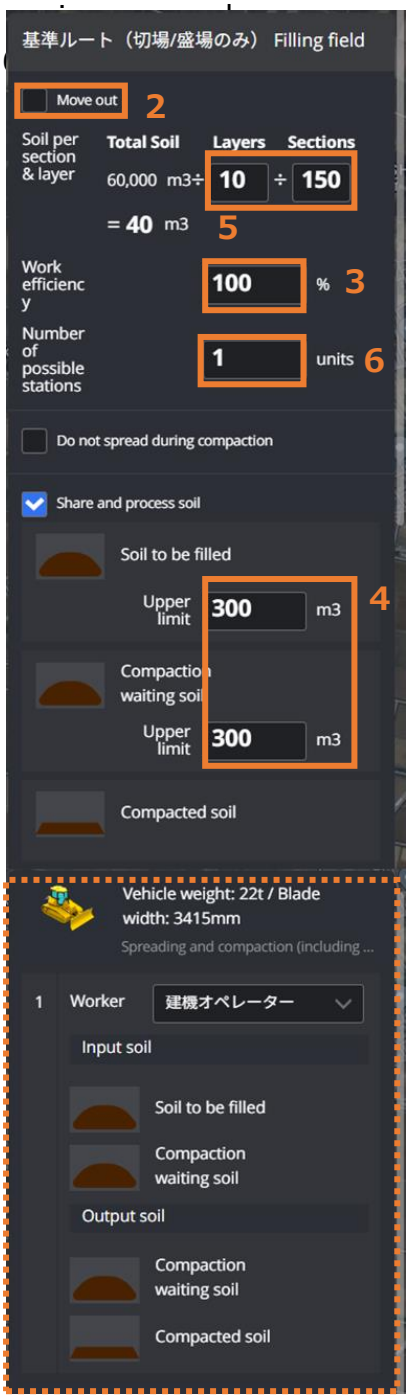
Settings for construction machines in the unloading area

2 If the construction machine in the loading/unloading area is managed by other company, check the box of it.
If you check the box, it is excluded from the costs to be posted.

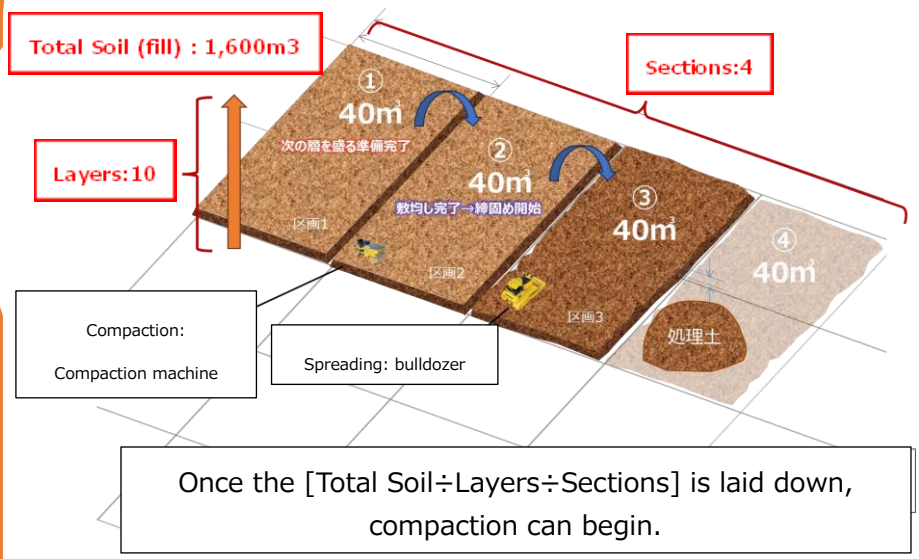
3 Make adjustments if the normal operational efficiency cannot be secured due to the jobsite environment, etc.

4 Soil volume to be left in the step due to the construction reason can be set.
Remaining soil volume is handled together in the next step.

5 You can set so that the compaction operation does not start until the soil awaiting compaction equivalent to the “Transported soil volume / Number of layers / Number of compartments (m3)” (volume of soil to be spread /compact a section of a layer)



5 Detailed description of soil volume in one layer and one zone (example)



Once the [Total Soil÷Layers÷Sections] is laid down, compaction can begin.

・ Initial value of number of layers: 10

・ Initial value of number of compartments: Total soil volume / 400 (rounded off)

Depending on the soil volume to be transported, it is adjusted so that the initial value of the soil volume per zone of one layer is about 40 m^3*.

*Defined as the initial value the soil volume whose discrepancy with the actual jobsite was small as the result of the past verification.

3.4 Settings of Dump Truck

If you change the construction procedures or other elements, they are not displayed, because the settings are reset.
Select the type of dump truck from the dump truck icon, enter the number of trucks, and add them.

Settings of dump trucks

3.5.1 Setting dump truck driving route

1 Drag a marker in the loading/unloading areas and point it to a designated position on the map.
In particular, if the loading/unloading areas are set outside the jobsite, adjustments are required.

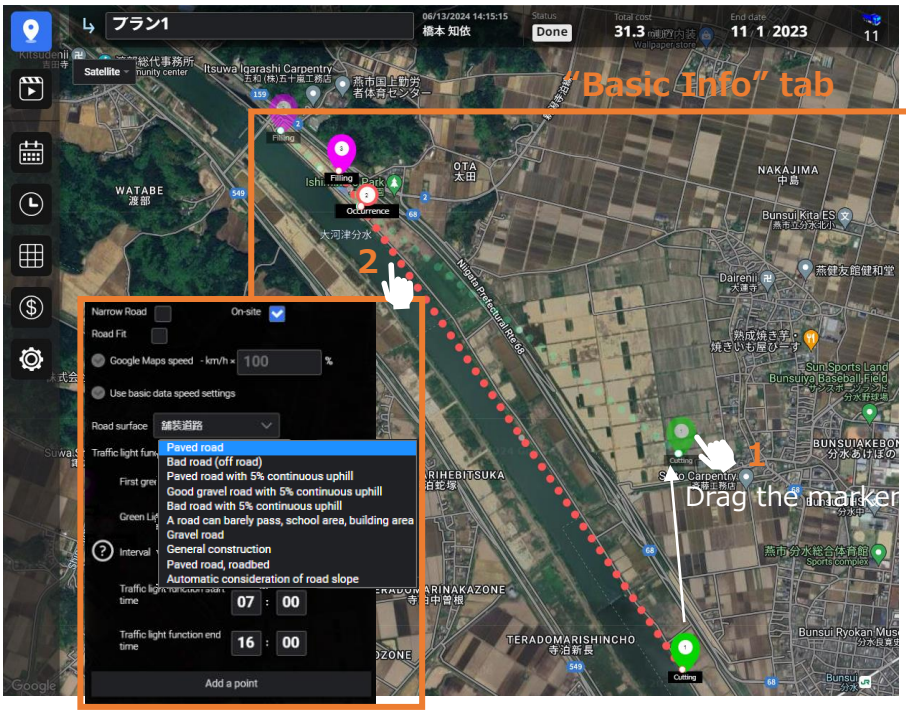
2 Add a point every time the driving conditions in the jobsite change, and select the road-surface conditions from the list.
Speed coefficient of each road-surface conditions can be checked and changed in “Basic data” > “Road surface”.

3 If it is in a zone in the driving route on the jobsite, check the box of “In the jobsite”. Set values of the speed in the jobsite can be checked and changed in “Basic data” > “Dump truck”. At the time of calculation, coefficient is added to the set speed according to the road-surface conditions set in 2.

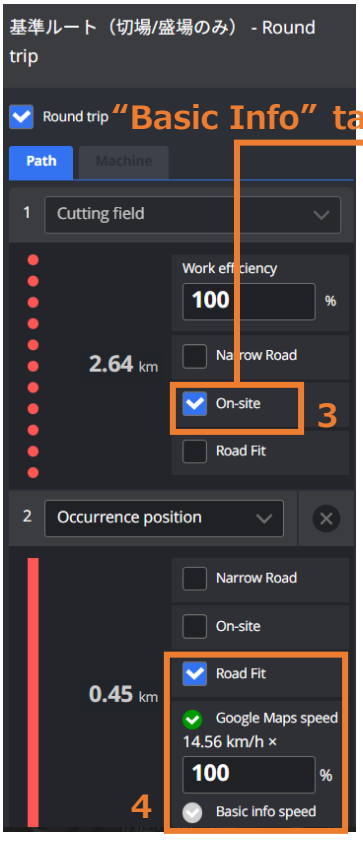
4 If you check the box of “Point it on the road of the map”, the route that passes the local road is automatically selected.

5 If it is a zone in which dump trucks cannot pass each other, check the box of “Narrow path (unable to pass each other)”.

6 Set up zones for waiting or for washing tires.
It affects the driving time (the required time can be changed from “Basic data” > “Dump truck”).

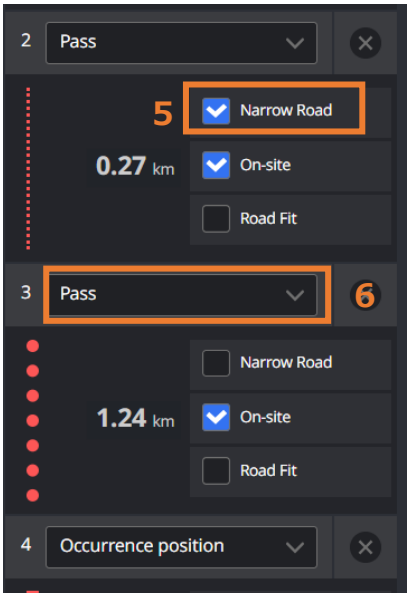


Category	Coefficient
Paved road	1
Bad road (off road)	0.9
Paved road with 5% continuot	0.9
Good gravel road with 5% con	0.85
Bad road with 5% continuous	0.8
A road can barely pass, school	0.8
Gravel road	0.95
General construction	0.95
Paved road, roadbed	0.95
Automatic consideration of ro	1
Automatic consideration of ro	0.95
Automatic consideration of ro	0.9
Automatic consideration of ro	0.8



Name	Off-site loaded vehicle speed	Off-site empty vehicle speed	On-site loaded vehicle speed	On-site empty vehicle speed
Load capacity: 10t	20 km/h	20 km/h	10 km/h	10 km/h
Load capacity: 2t	20 km/h	20 km/h	10 km/h	10 km/h
Load capacity: 4t	20 km/h	20 km/h	10 km/h	10 km/h
Load capacity: 20t	20 km/h	20 km/h	10 km/h	10 km/h
Load capacity: 36.5t	8 km/h	8 km/h	8 km/h	8 km/h
Load capacity: 40t	20 km/h	20 km/h	10 km/h	10 km/h

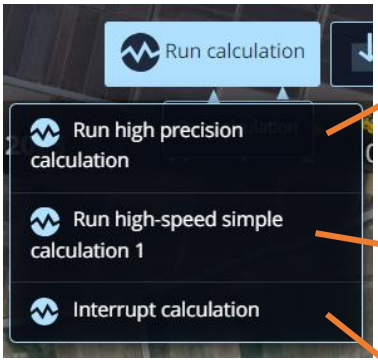
On-site loaded vehicle speed	On-site empty vehicle speed
10 km/h	10 km/h
10 km/h	10 km/h
10 km/h	10 km/h
10 km/h	10 km/h
8 km/h	8 km/h
10 km/h	10 km/h



7 If there are driving-route settings of several steps in the same zone, points can be integrated by laying a marker on another marker.
You can cancel it by a left click.

3.5.2 Executing calculation

1 Click “Calculate” and select the mode.
Simulation calculation starts.
Depending on the scale of the jobsite, if a high-precision calculation is executed, it may take as long as a day. Please try a simple calculation depending on the situations.



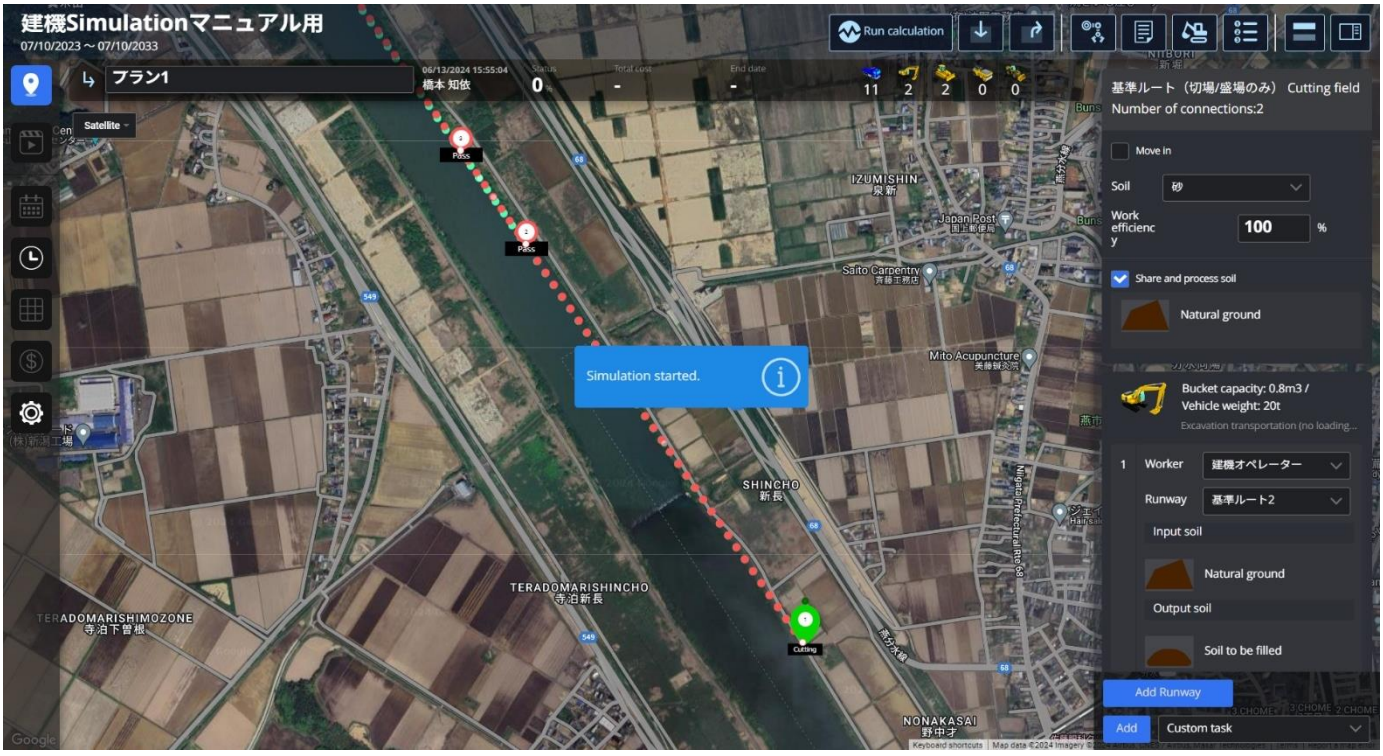
Detailed calculation on all periods of all driving routes is carried out every second.

The calculation is carried out on each road only for the first day, and the information from that first day on the soil volume on the road is copied.

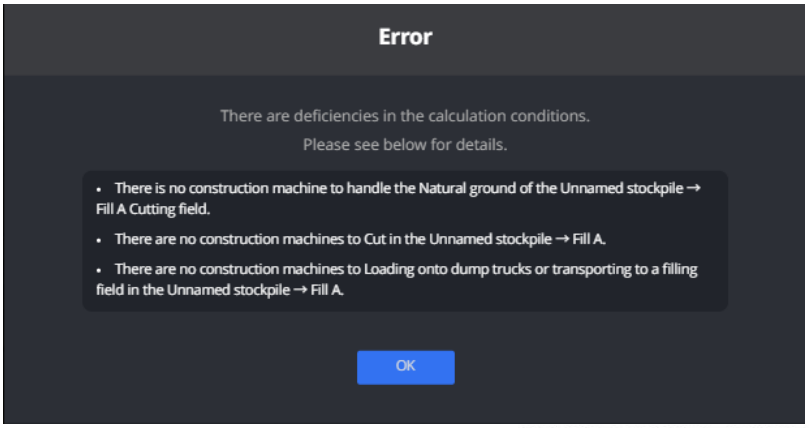
Cancel unfinished calculation process

2 Operation capacity of each machine can be checked and edited before executing the calculation.
Values can be edited from “Edit basic data” and calculated with the content edited by “Save”.

3 If there is no problem in the settings for executing the calculation, a message for starting the simulation is displayed.

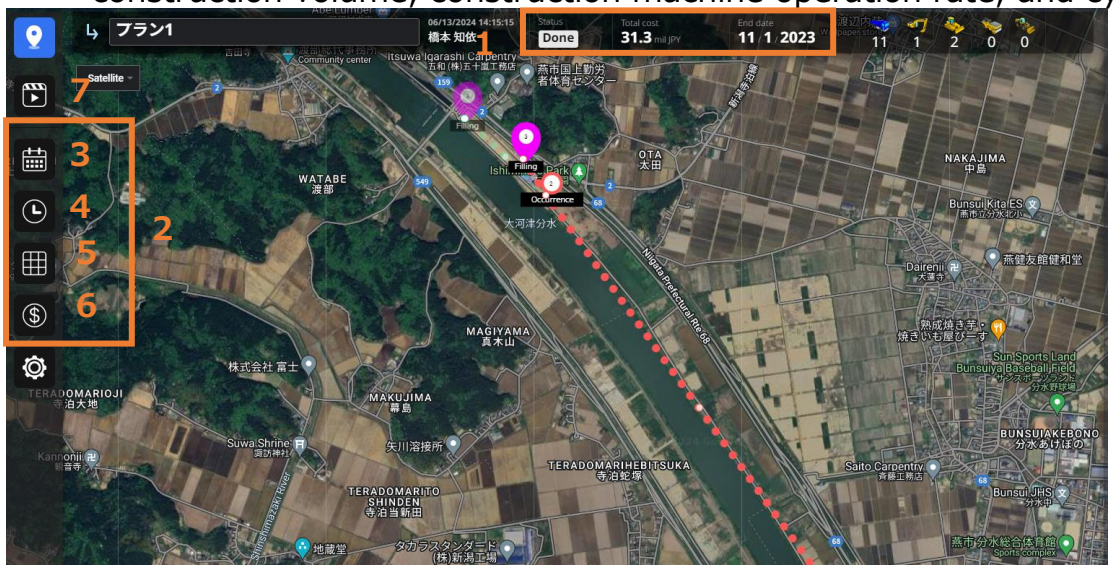


4 If there are any problems in the settings, the corresponding step name and details of the problem are displayed. Refer to the error contents and reset them.

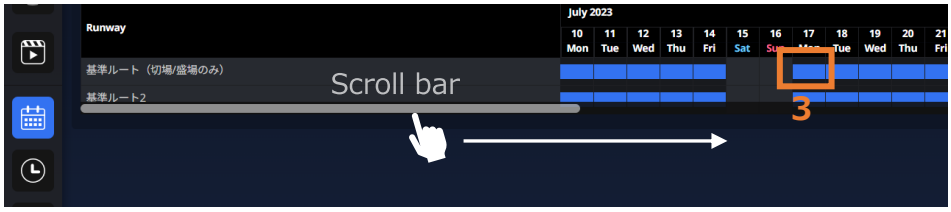


3.6 Confirming the Construction Machine Operation Simulation Results

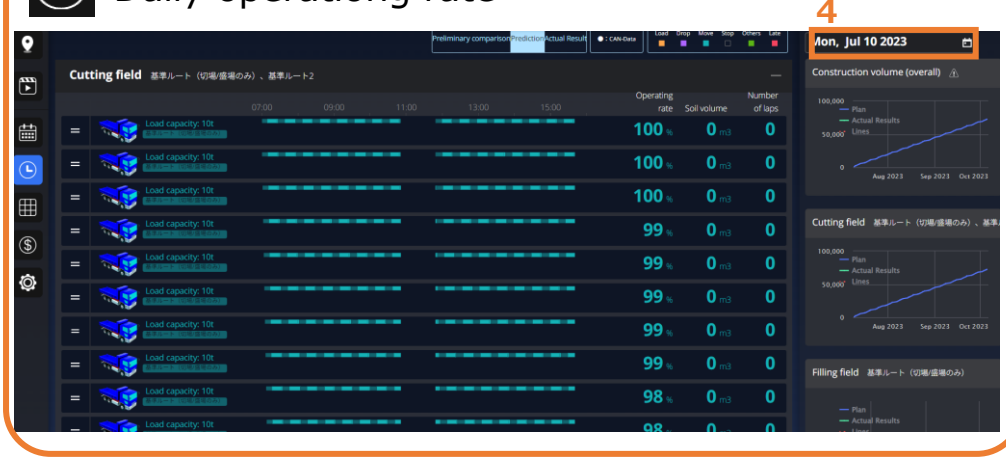
1 When the calculation is completed, costs and end date are simply displayed.
2 Process chart, daily operation rate, and costs can be checked from each icon.
3 Process chart
If you move the scroll bar aside, the entire chart shows up.
If you click the box of date, it brings you to the page on operation rate by day.
4 Daily operationg rate
If you select an operating days of construction machine, you can check the daily construction volume, construction machine operation rate, and cycle time.



Process chart



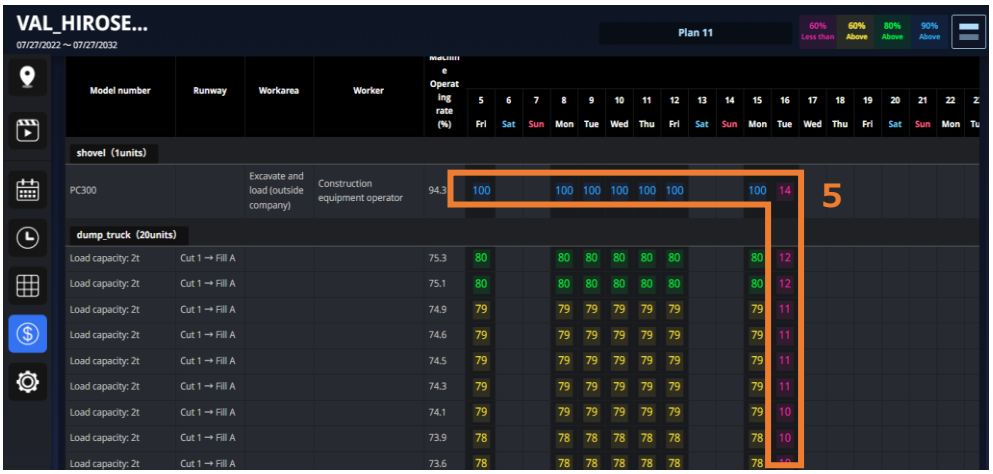
Daily operationg rate



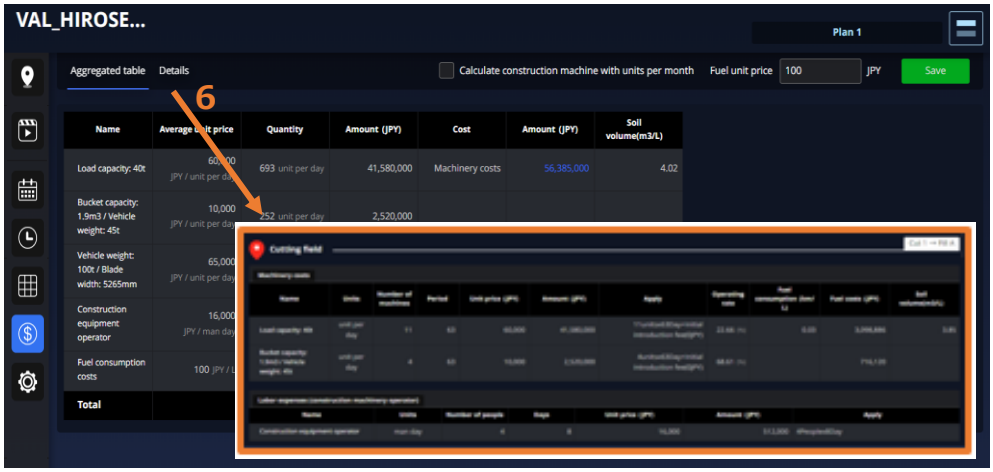
5 Operation rate calendar
If the operation rate is low, it is needed to consider reviewing the specifications, formation, and number of machines.

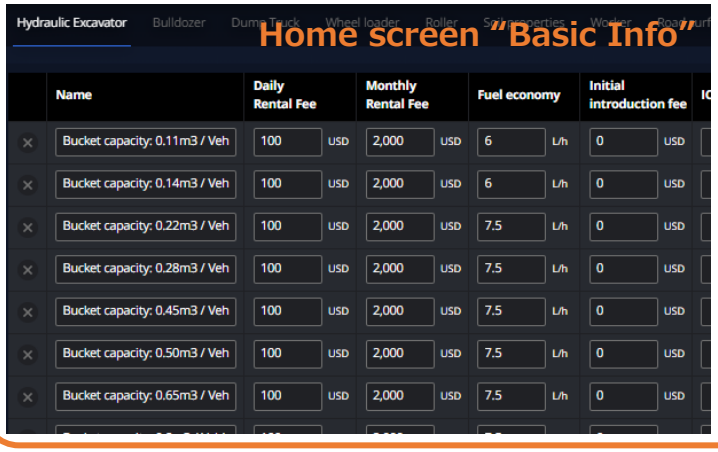
6 Cost table
You can check the construction costs, which are the results of calculating the detailed costs of each working place and the total costs.
Unit cost can be checked and edited in “Basic data” on the home screen.

Operation rate calendar



Cost table

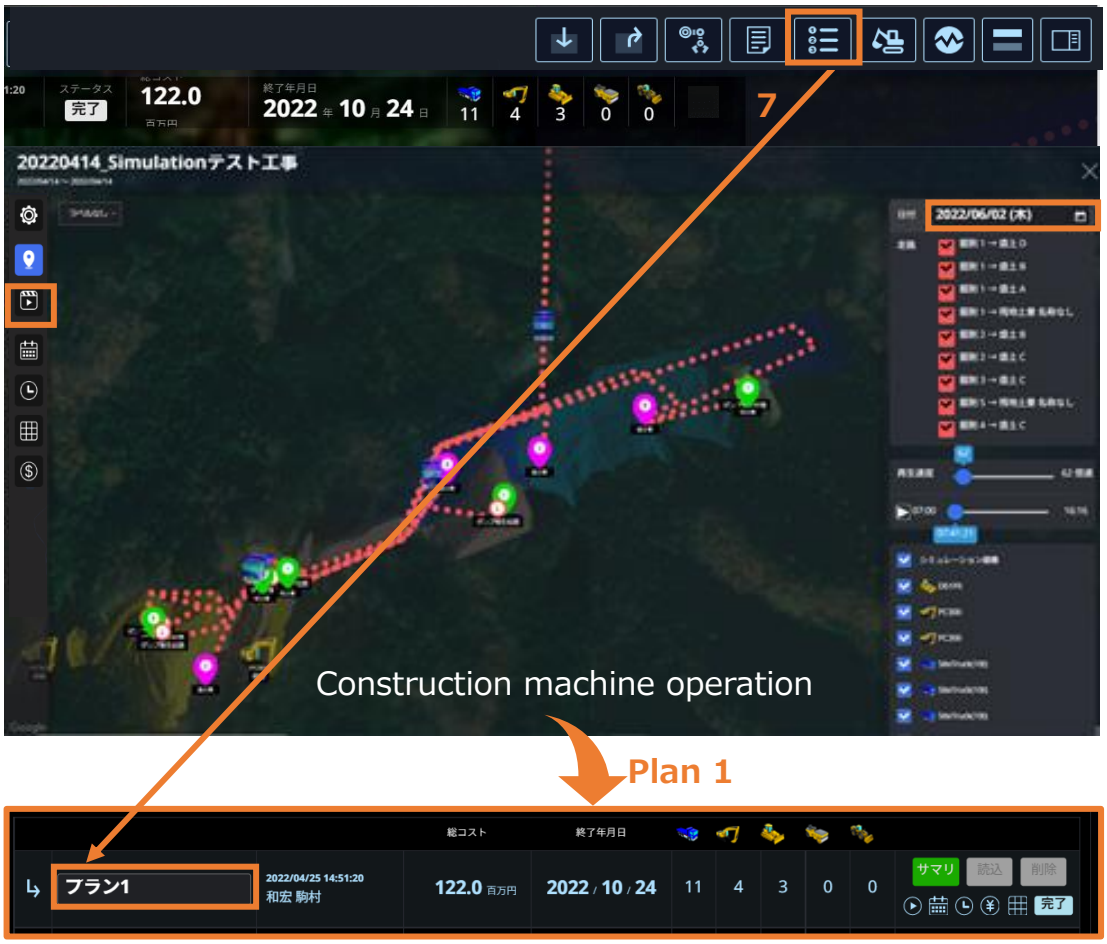




7 Dump truck operation animation

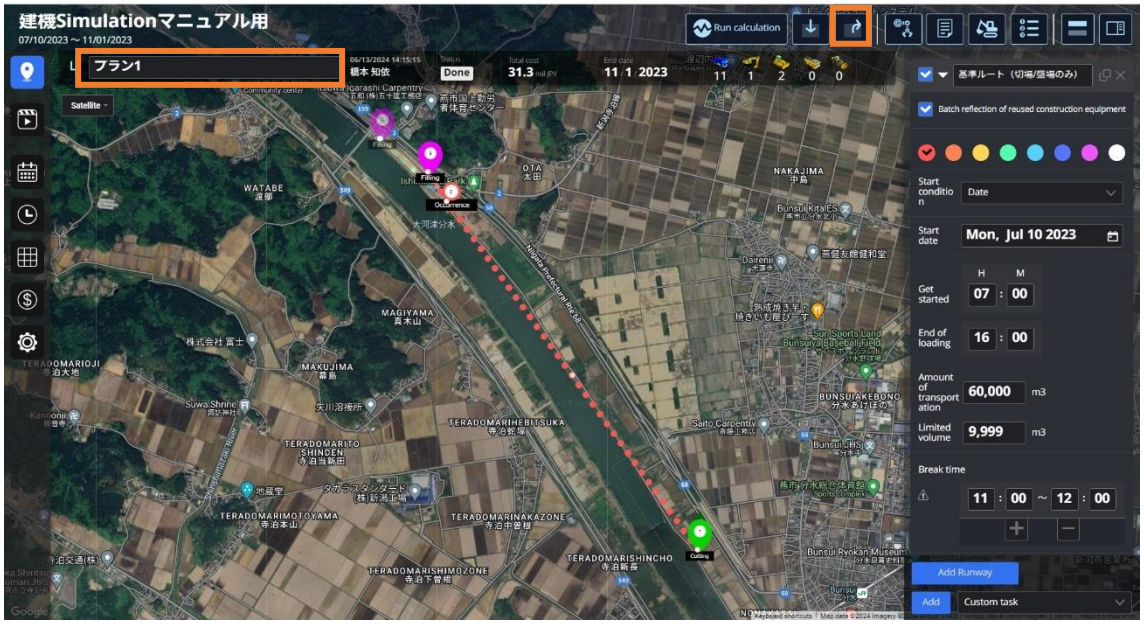
You can check the daily operation status of dump trucks in animation.

Dump truck operation animation



8 Save as

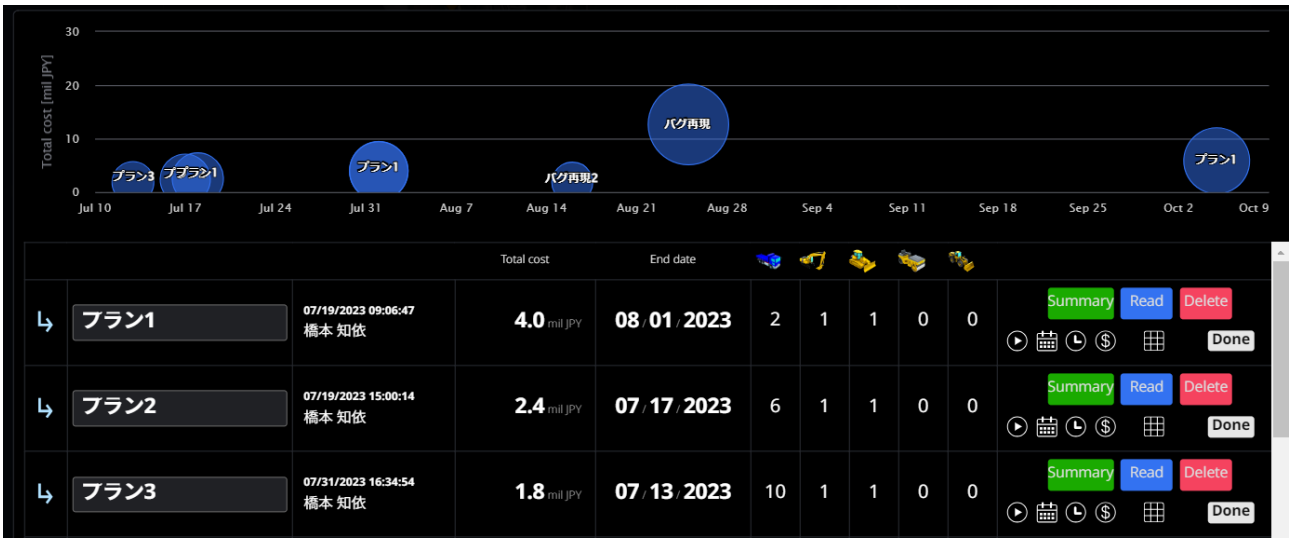
A created plan can be saved.



※ Change the plan name, and, in principle, use “Save as”.
(If you use “Save”, what you entered is overwritten, i.e. the former plan will be overwritten.)

※ **If you press “Save” after calculation, the calculation results will be lost. Please be careful.**
(“Save” in this case means saving the route or settings.)

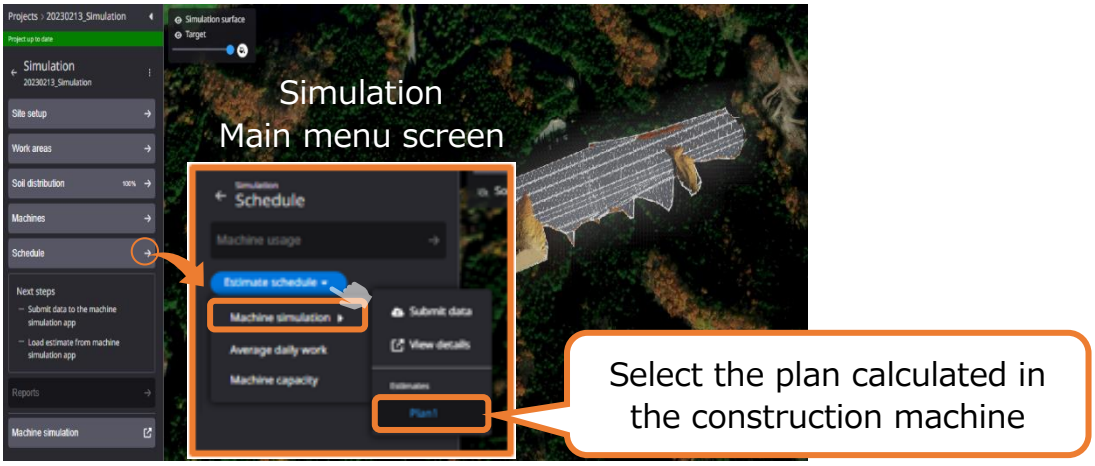
※ **The calculation results are automatically saved after calculation. Therefore, it is not needed to press “Save”.**



3.7 Loading the construction machine operation calculation results on the soil distribution plan simulation side

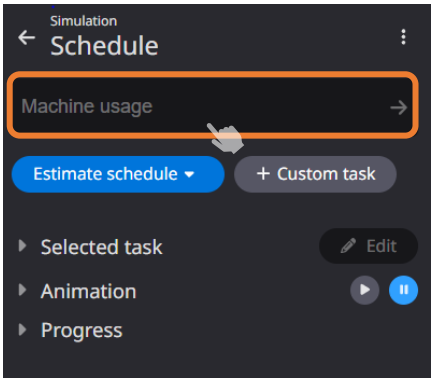
The results of calculation on the construction machine operation simulation side can be loaded on the soil distribution plan simulation side.

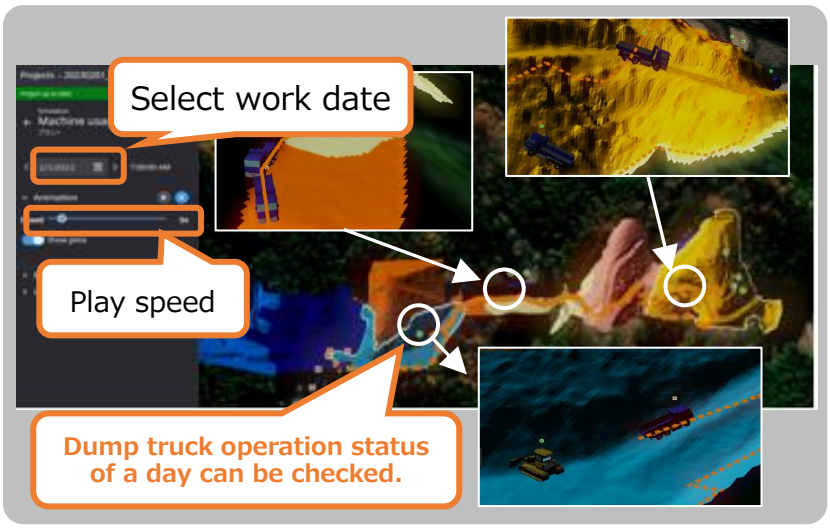
1 Select the calculated plan in “Schedule” > “Estimate schedule” > “Machine simulation”



2 If the data is loaded, a new operation process chart will be displayed.

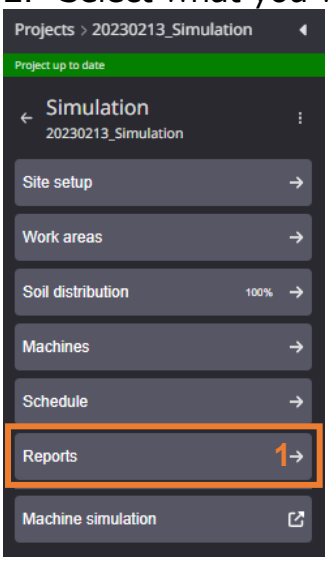
3 Press “Machine usage”, specify the work date, and press the “Play” button of “Animation”.
You can check the construction machine cycle time of the specified day and operating status of the construction machine in animation.

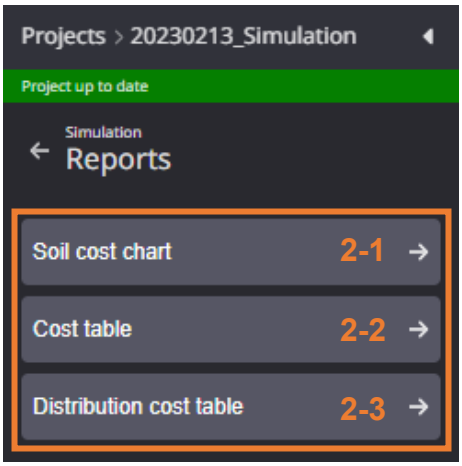




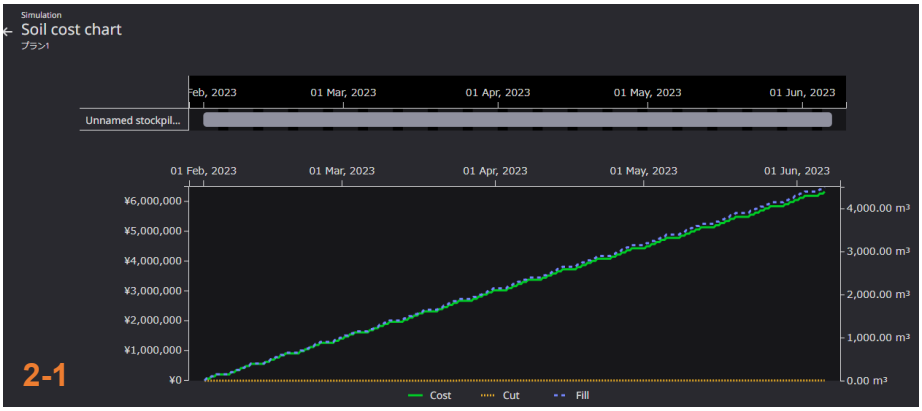
3.7.1 Calculating costs

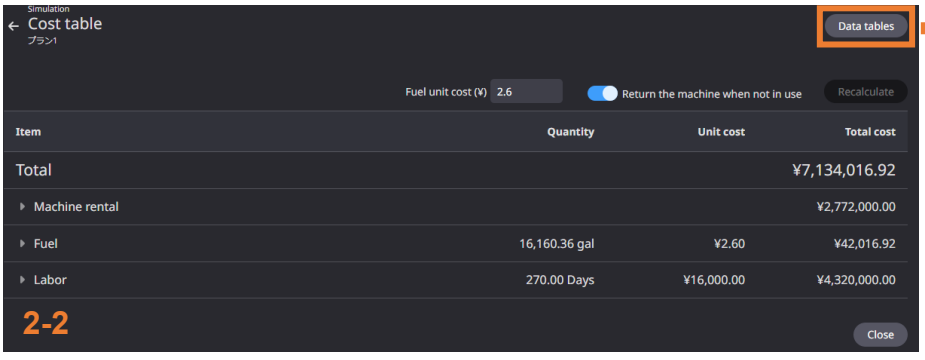
1. Press “Report”.
2. Select what you want to browse.

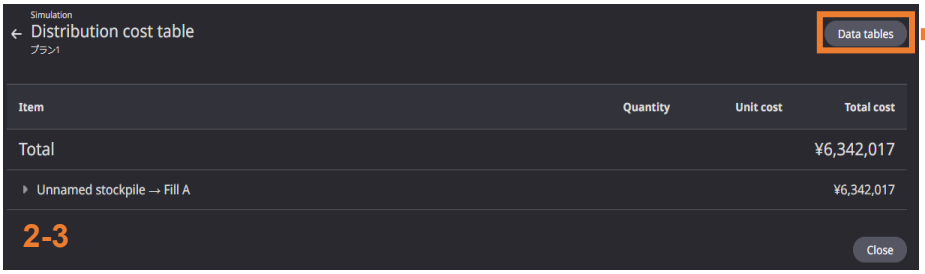


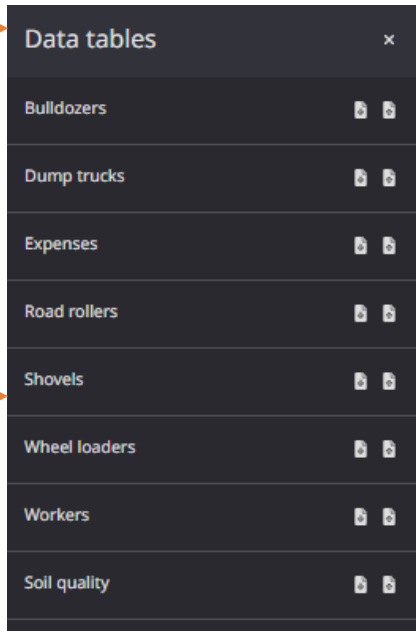


2





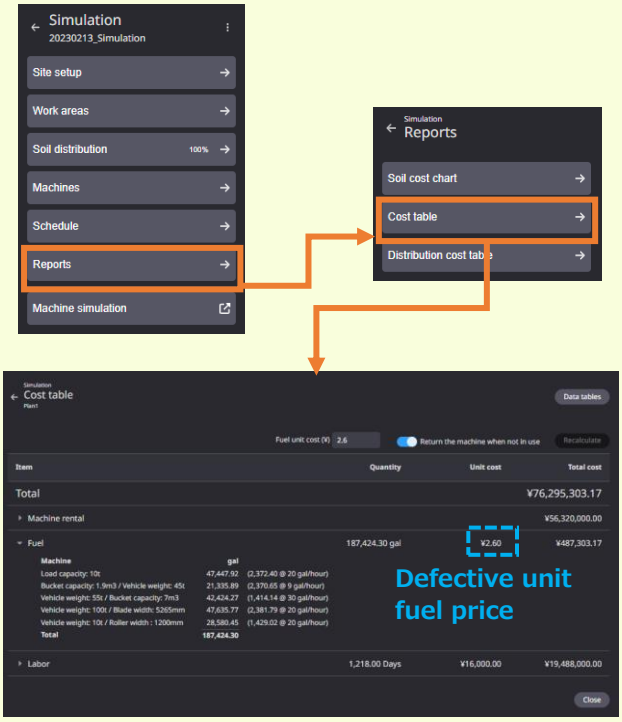




Attention

There are two types of construction cost calculations.
(soil distribution simulation and construction machine simulation)
Soil distribution simulation is faulty in fuel calculation. Please refer to the construction machine simulation.

Method 1: Calculated from soil distribution Simulation



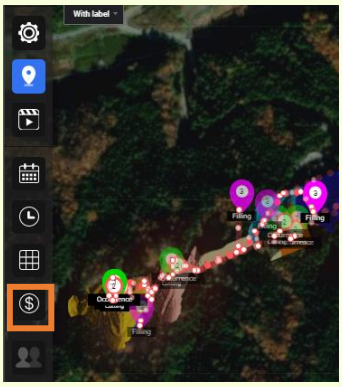
Mechanical cost calculation logic

Construction machinery: work days only, not weekends
Dumps: Only work days, not weekends
(※○t Dump, including machine and labor charges)
(※Heavy dumps are for machinery only)

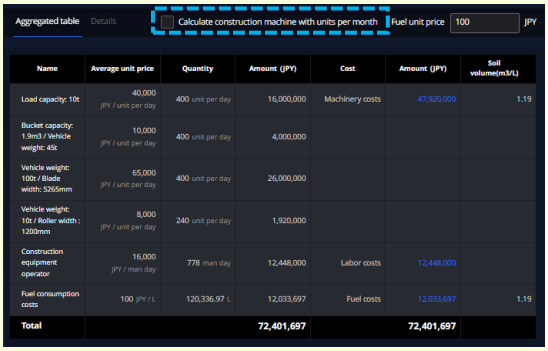
labor cost calculation logic

Work days only, not weekends

Method 2: Calculate from the construction machine simulation



Not recommended for monthly calculations, as monthly discount logic is applied



Mechanical cost calculation logic

Construction Machinery: **From Start to Finish including Saturdays and Sundays**
(※ calculated based on the × construction period for total construction machinery)

Dumps: Only work days, not weekends
(※○t Dump, including machine and labor charges)
(※Heavy dumps are for machinery only)

labor cost calculation logic

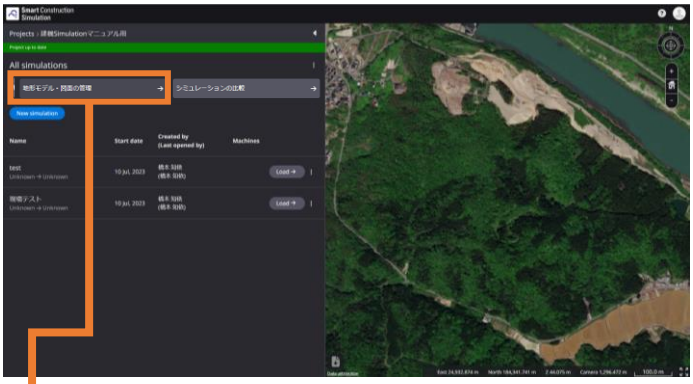
Work days only, not weekends

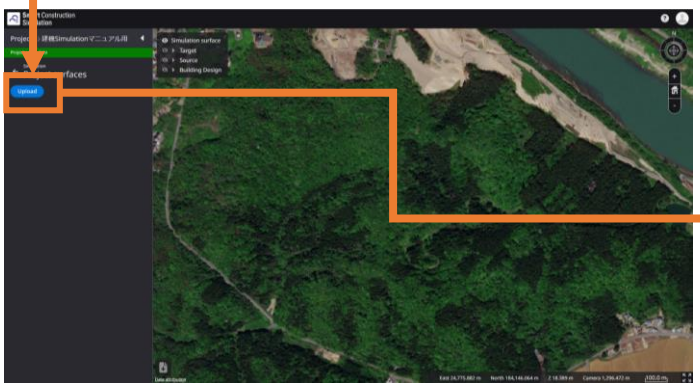
4 Re-planning

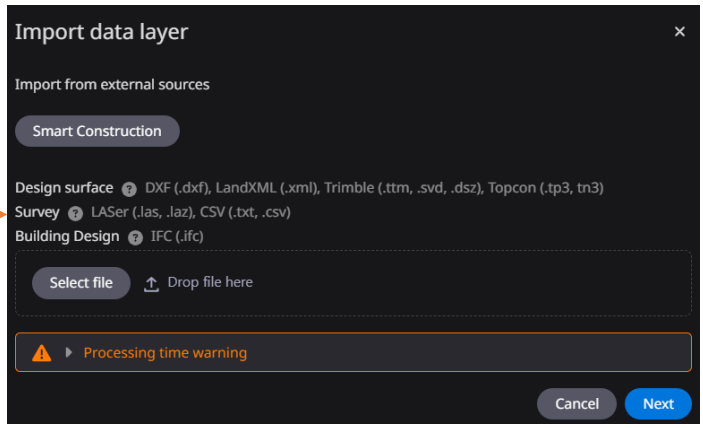
4.1 Register the halfway topography

*This function can be used if you want to check the progress status at the current time and perform the re-planning from the halfway topography, while reflecting the halfway topography (results) in the plan established at the beginning, and taking over the basic information including entrance information and the settings for each area.

1. Upload the topography under construction acquired by a drone, etc.



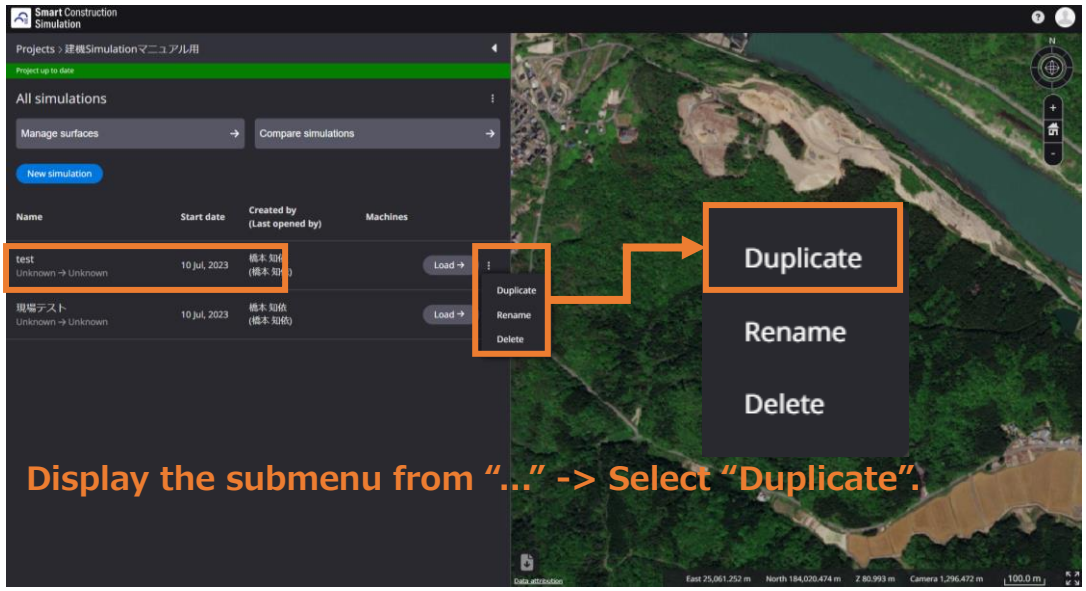




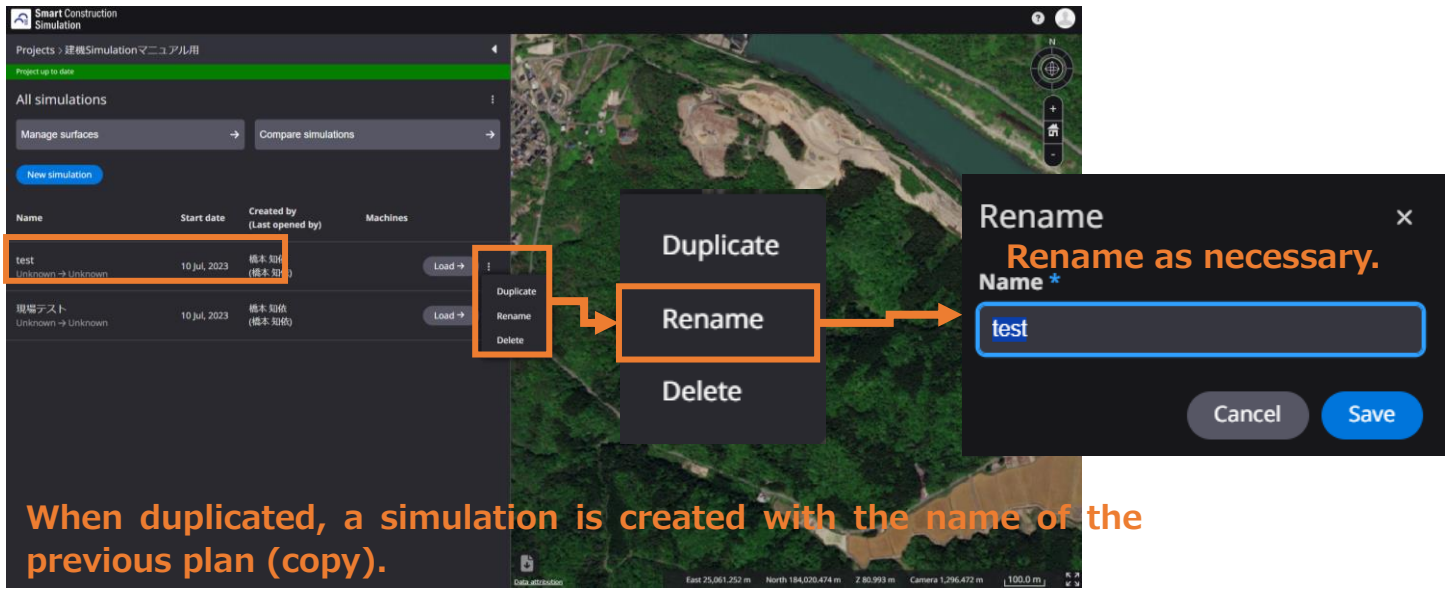
Upload the halfway topography from Select file.

4.2 Duplicate the created simulation.

1. Duplicate a simulation you want to re-plan.

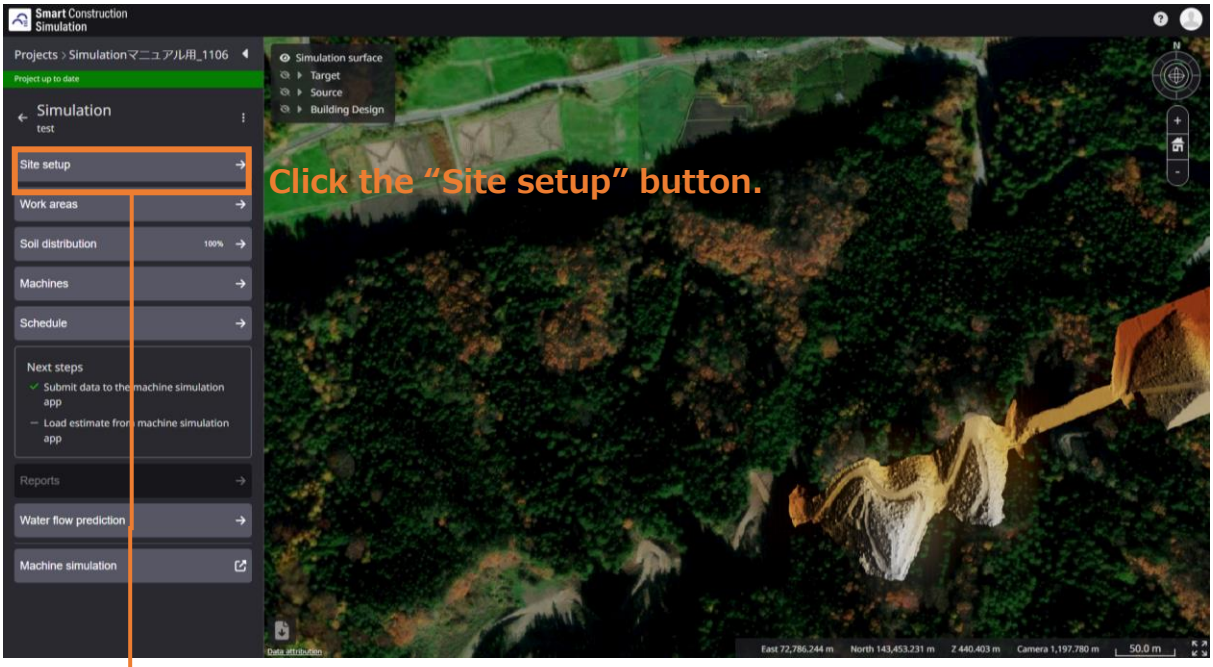


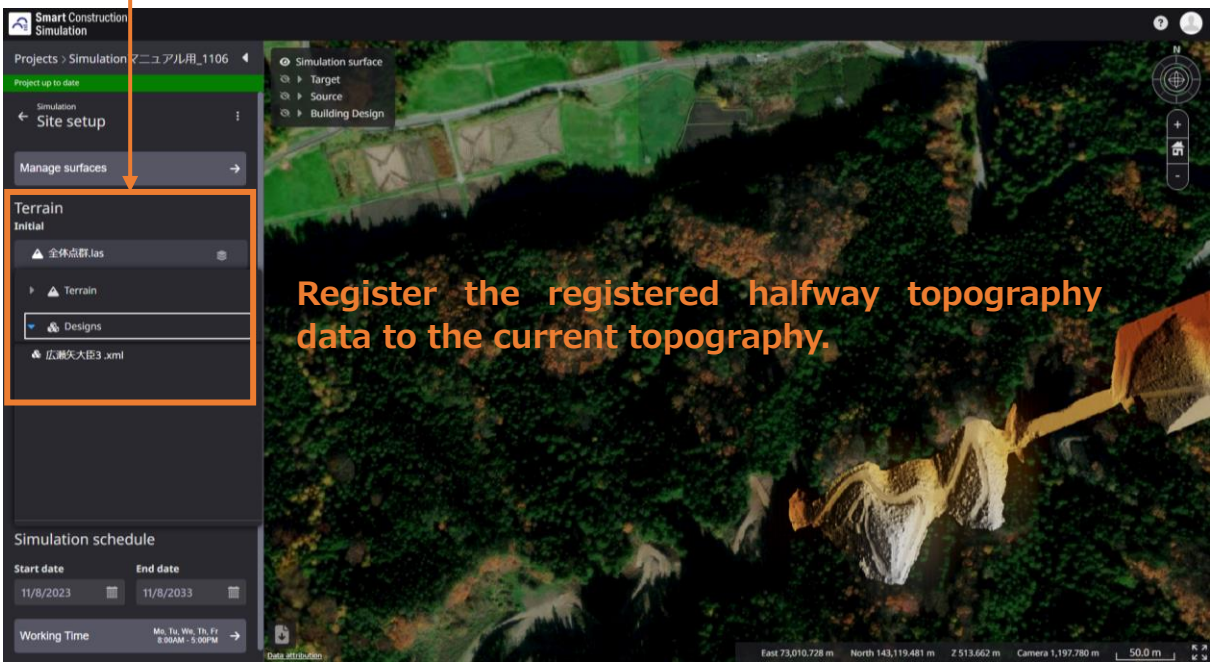
2. Rename the simulation.



4.3 Set up the halfway topography

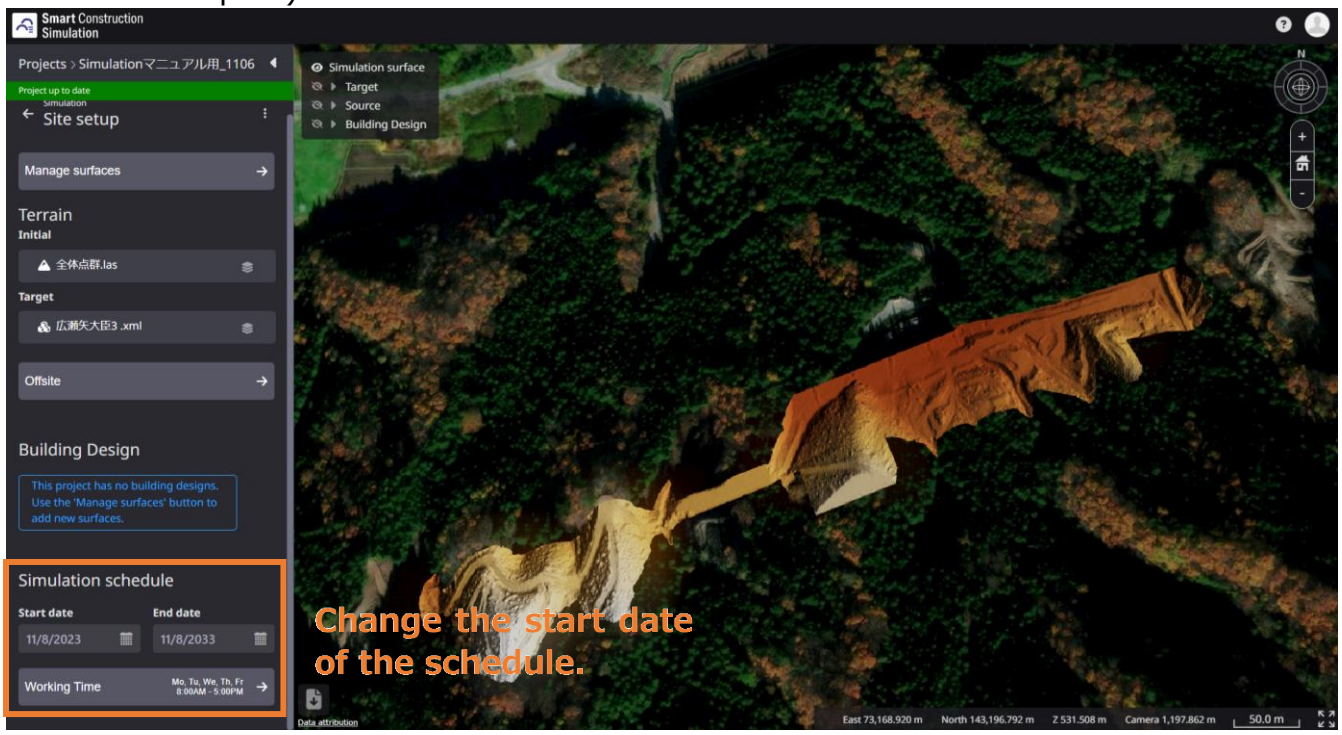
Open the copied simulation.
Set the halfway topography of construction registered in Section 4.1 as the simulation topography.

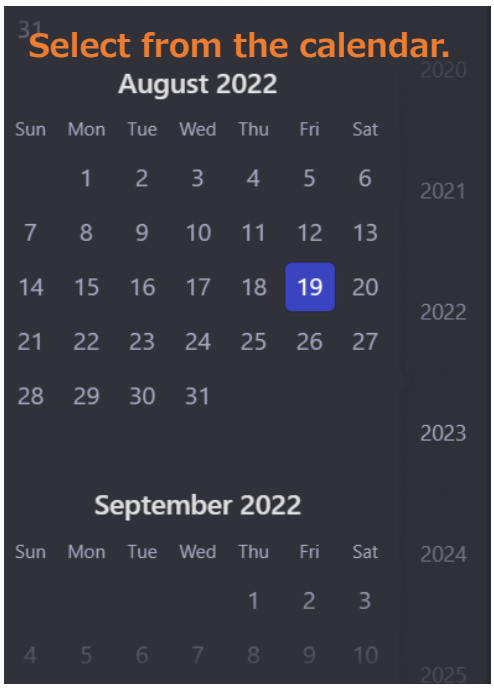




4.4 Set up the construction schedule

Set the measurement date on which the halfway topography is acquired (date you want to review the plan).

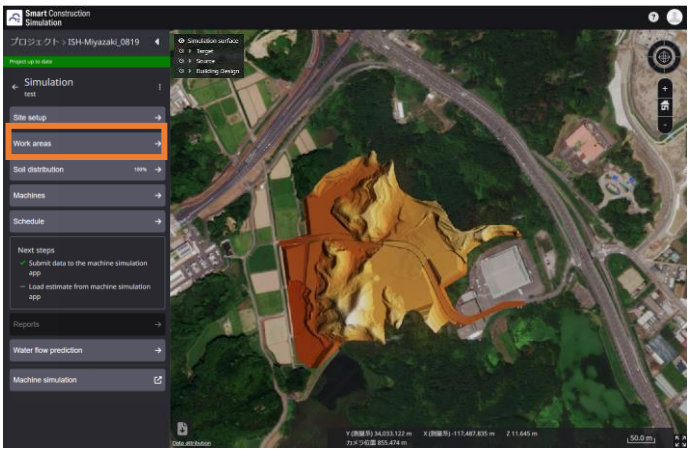




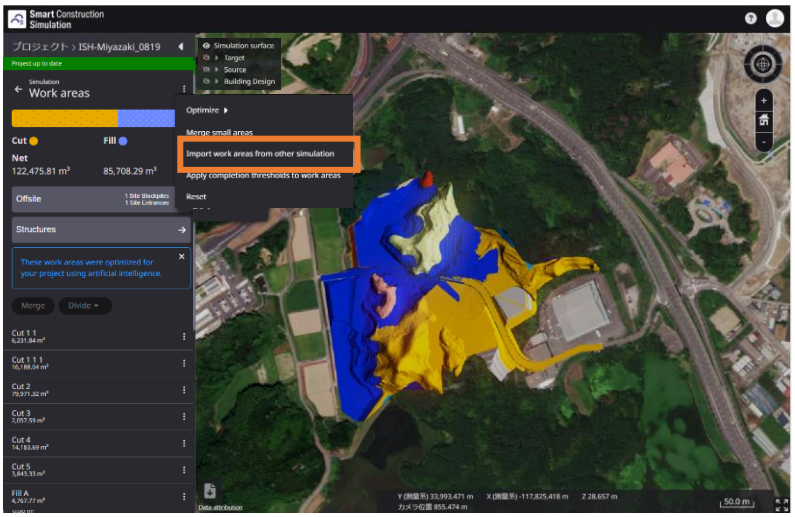
Changes are reflected.

4.5 Set the plan handover source

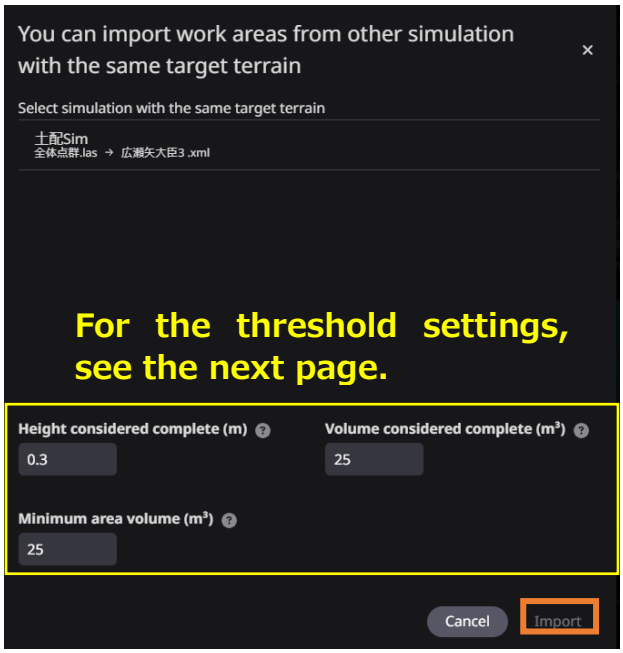
1. Press the “Work areas” button.



2. Select “...” -> “Import work areas from other simulation”.



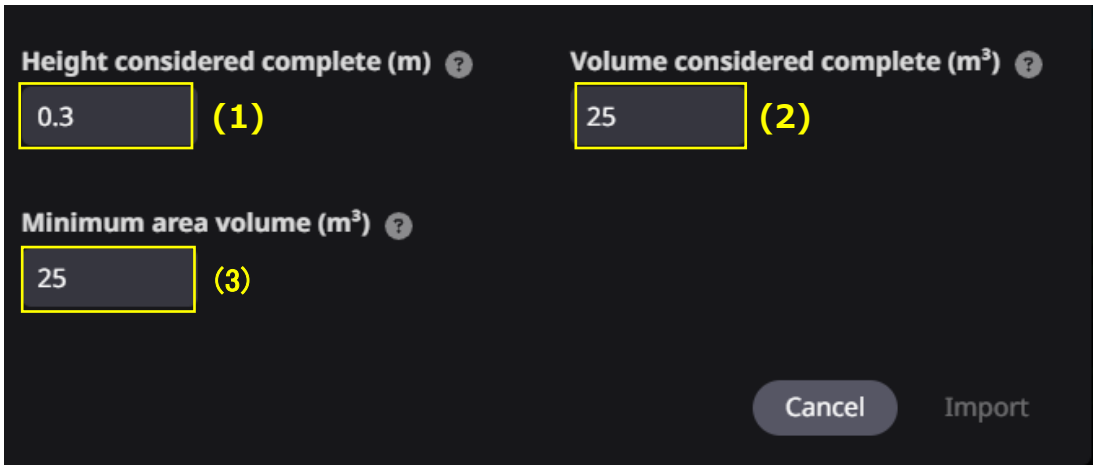
3. Select the initial plan and the plan you want to take over, and press the "Import" button.



Select a simulation to take over.

Import

[Detailed description] Area takeover function settings



(1) A position where the difference of the height between the halfway topography and the design surface is less than this value is considered to be “Complete”.

It is considered as complete if the height is equal to or less than the specified height.

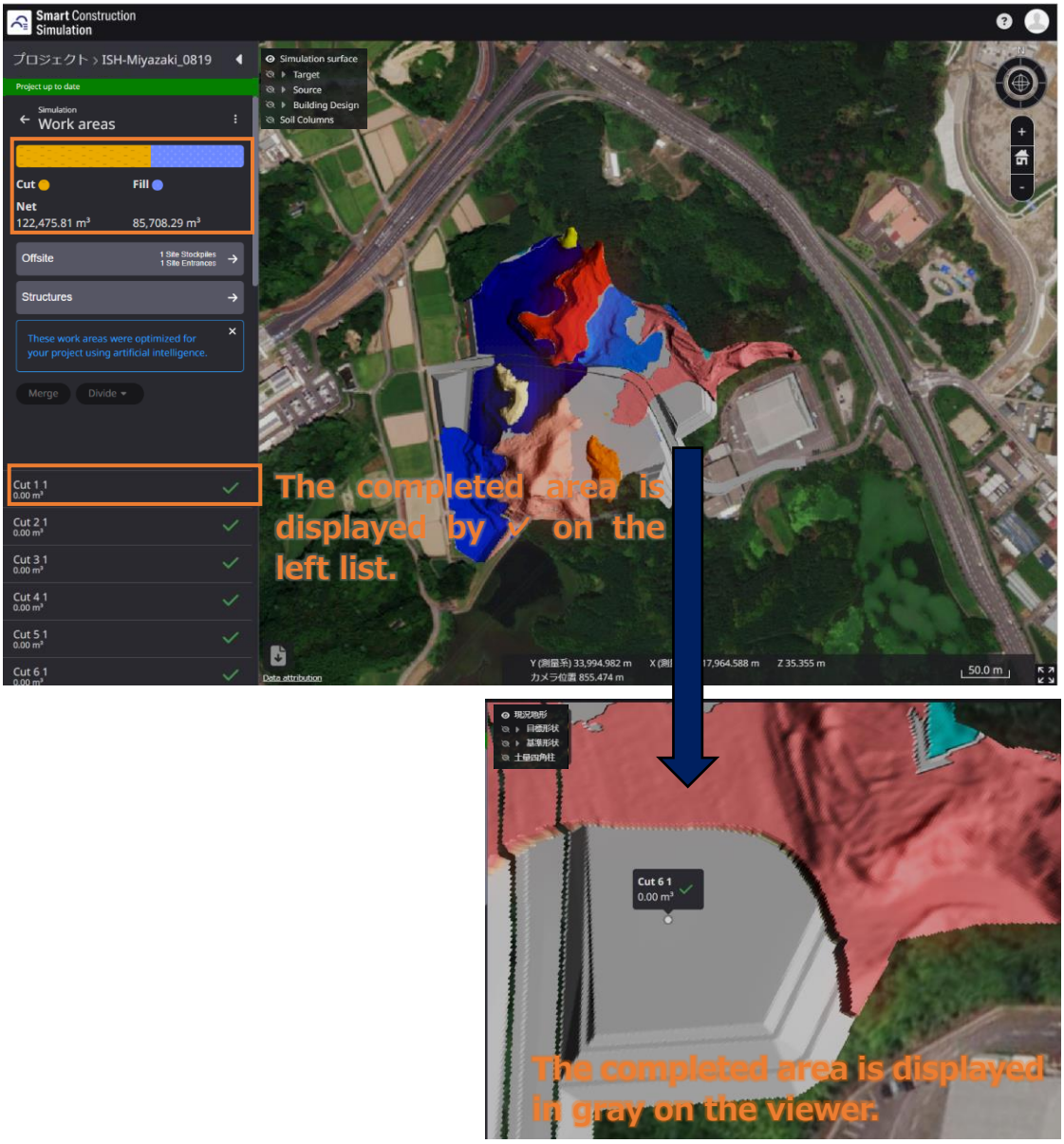
Note

If the threshold is set to 0 m, it is recognized as an incomplete area even at a slight height, and multiple minute areas (≦1 m^3) may occur.
If multiple minute areas are generated, the soil distribution settings may not work correctly.

(2) An area which is not yet completed and whose volume is less than the threshold value is considered "Complete".

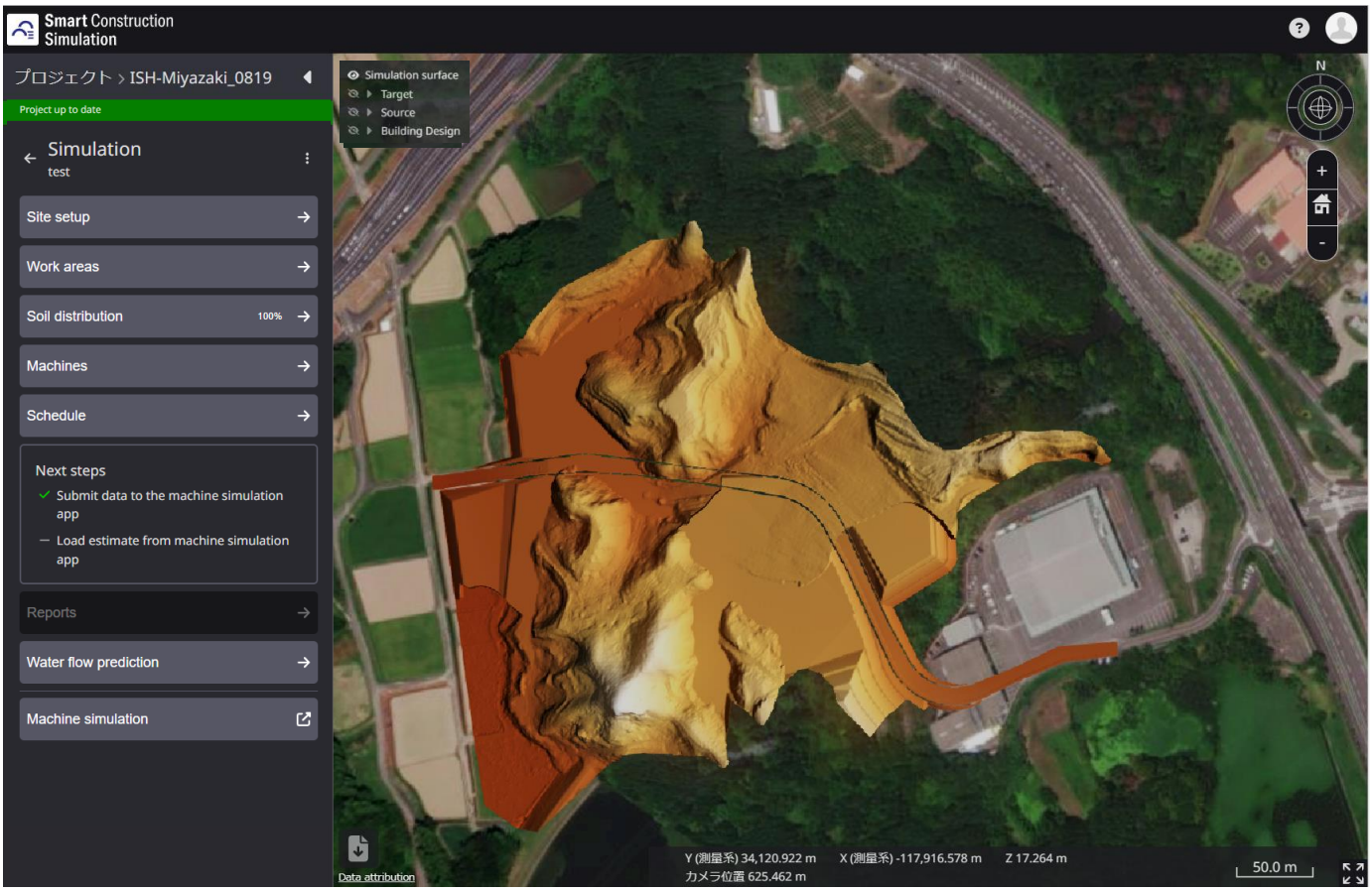
(3) When not completed and a new area is generated, the new area with a volume below this threshold value will be merged.

4. The area information is taken over, and the area takeover and completed topography are visualized.



4.6 Set up the soil distribution plan

Refer to sections 1.10 to 1.13, and re-develop the soil volume distribution plan.



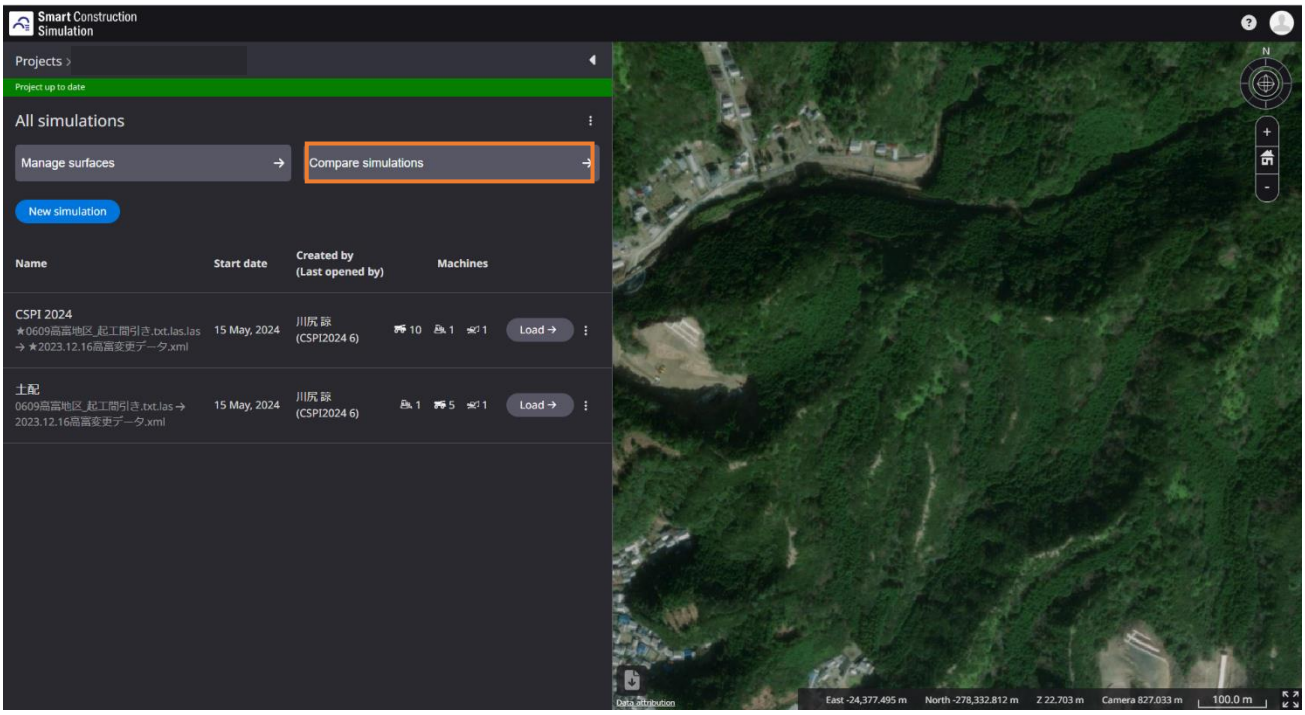
If you plan the soil distribution, the “Settings of construction machine” data will be linked from the plan automatically created at the start and the plan you want to take over.

Note: “Settings of construction machine” is taken over only if “Taking over halfway topography” is performed from “Plan copying”.

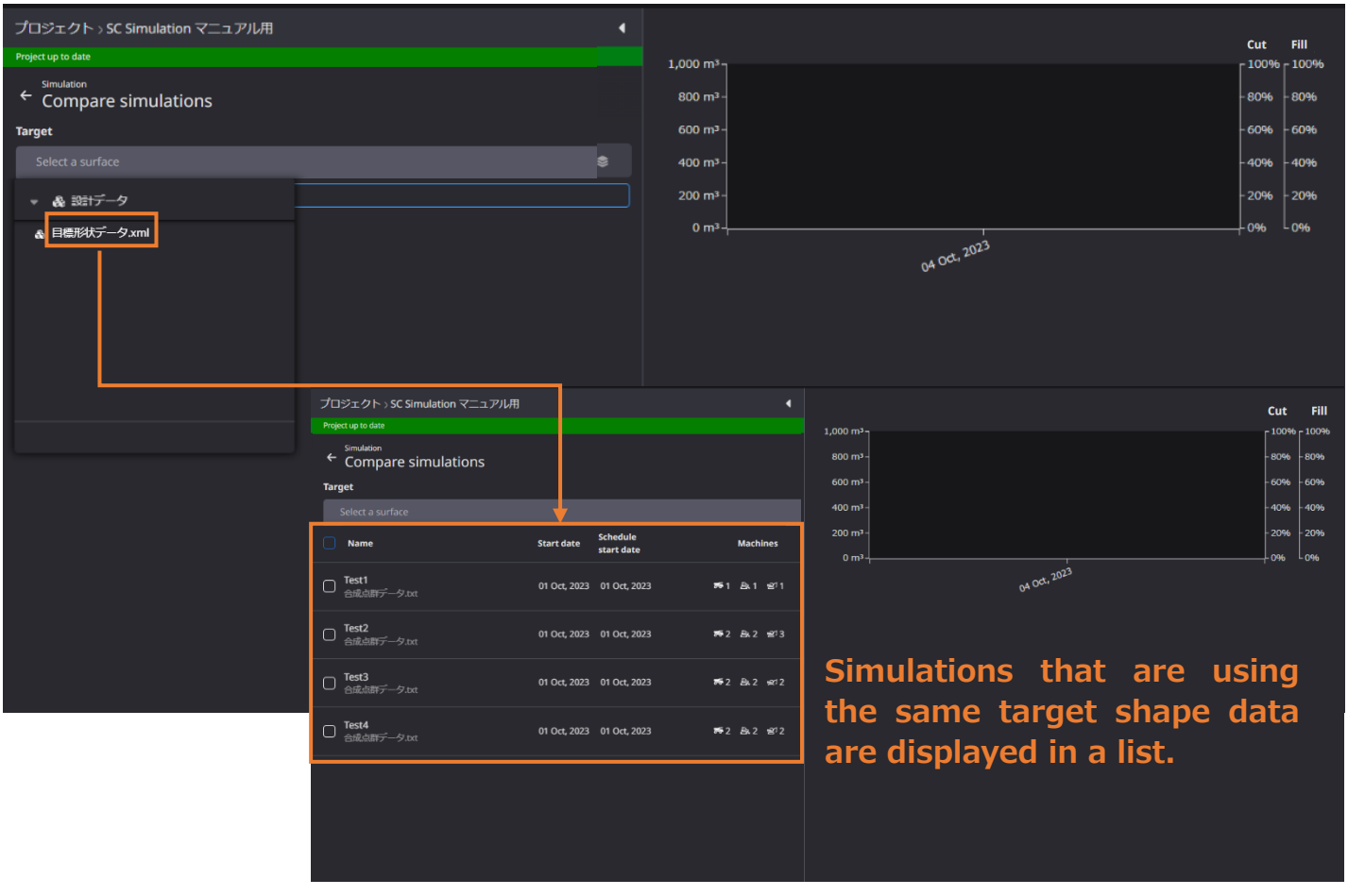
If “Taking over halfway topography” is implemented from “New Simulation”, it will not be taken over.

Simulation comparison

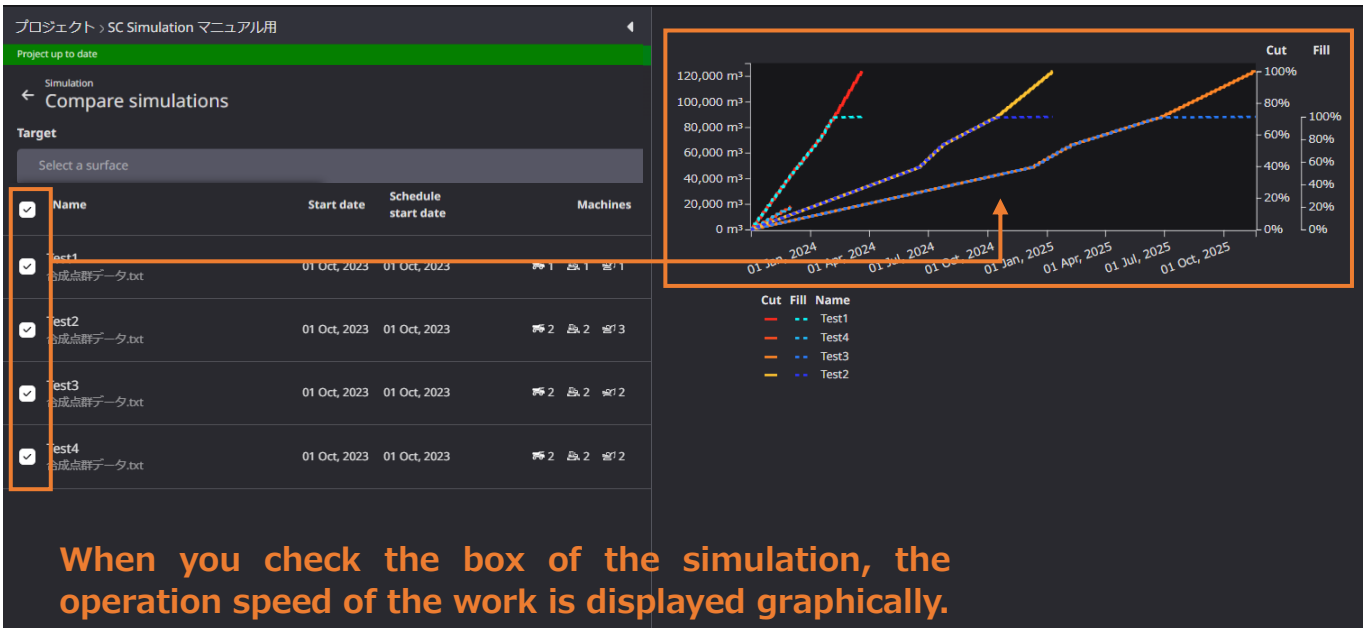
1. In the simulation list, press “compare simulations”.



2. When selecting a surface, select the target shape data used in the simulation.



3. If you check the boxes of simulations you want to compare, a chart will be displayed.



Attenstion

Simulations without a process chart will not be included in the graph display.

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  EARTHBRAIN Ltd.
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  https://www.earthbrain.com/contact/form/

- Contact at the time of malfunction
  Please contact Smart Construction Support Center.

6 Revision history

Created/revised date	Manual version	Description
2022/08/10	0001	Initial version
2022/12/19	0002	The Introduction of construction machine simulation function (pp.38-39) was added.
2023/02/16	0003	“4. Re-planning” with the addition of the plan takeover function (pp.55-62) was added.
2023/11/10	0004	“Add the function of traveling area settings” (pp.27-28), “Add optional task” (p.37), “Process chart output” (p.38), and “Simulation comparison” (pp.73-74) were added.
2024/1/17	0005	In “3.1 Explanation of construction machine operation simulation on home screen”, UIUX were changed (p.47). Confirmation of work capacity before executing calculation (p.56) was added.
2024/2/20	0006	In “2.3 Taking over operation procedures and construction machine formation to construction machine simulation”, a note was added (p. 45). “Dump truck operation animation button” was changed (p.60).
2024/4/24	0007	The specifications of the number of layers setting was chanded (p.54).

Smart Construction Simulation Quick Guice

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