

# 4D construction learning environment

## virtual tour making

## 2. Node mapping

### **Team leader:**

Dr Chris Landorf

### **Contributors:**

Rick Hill

Marc Steffens

Lorinne du Toit

### **Edited by:**

Rick Hill

Lorinne du Toit

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School of Architecture

The University of Queensland

<http://4dconstruction.architecture.uq.edu.au/>



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Requests and inquiries concerning these rights should be addressed to:

Dr Chris Landorf  
School of Architecture  
The University of Queensland  
Brisbane Queensland 4072

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# 1 Mini-map

The mini-map graphical object provides a key navigation tool for users. A plan for each floor level to be surveyed will need to be drafted at an early stage. These plans should be based on Architectural design drawings to ensure accuracy with the actual construction project. This presumes that the 4D project team will have access to architectural drawings.

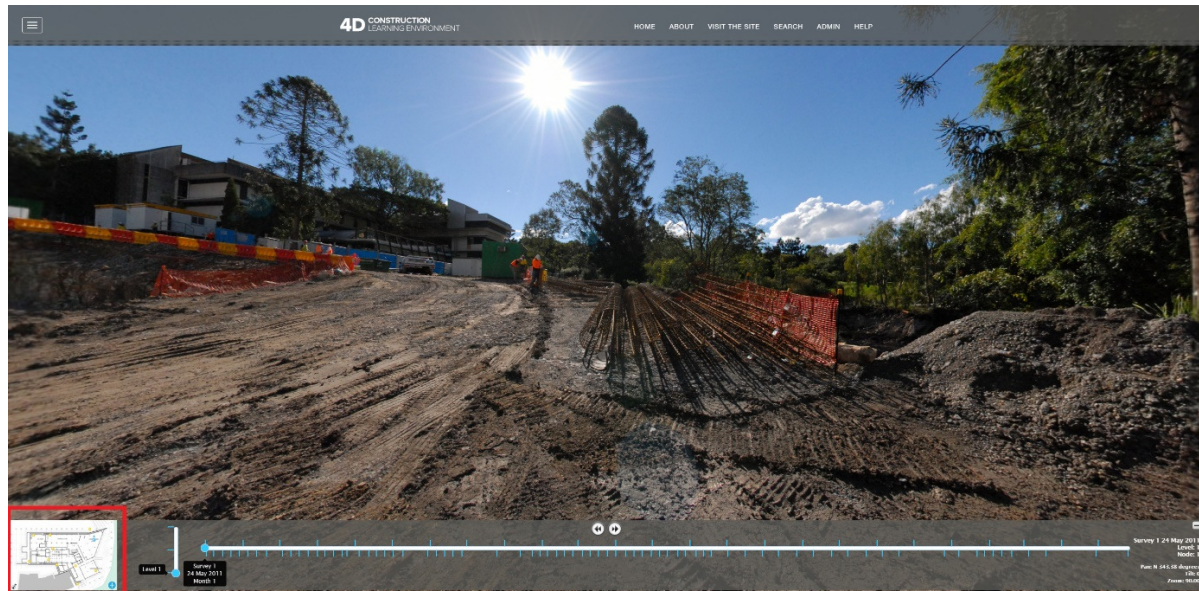


Figure 1 Typical 4D learning environment with mini-map bottom left (highlighted with red box)

## 1.1 Initial setup

The mini-map plans can be drafted in any suitable CADD program (eg. Revit, Archicad, Autocad, Sketchup) that can produce and export scaled plan drawings in PNG format (see section 1.3 Exporting for more detail).

Orientation of the mini-map plan(s) should be considered. It may be more useful to show the project drafted in one particular orientation, but this decision should always be considered in light of the supporting documents available (design and consultant drawings and documents) and every attempt made to match those.

## 1.2 Drafting content

When drafting the first mini-map plan, some decisions will need to be made regarding style and an appropriate level of detail. Drafting conventions should be adopted that will convey enough information for users to clearly understand the project. This will probably depend on the scale of the project (smaller projects could include more drafted detail and remain legible).

### 1.2.1 Detail and legibility

The mini-map needs to be legible at small size (in the bottom corner of the 4D application). However, the drawings also need enough detail for users to be able to examine the main features when the map is zoomed up to maximum size. Compare Figure 1 above (mini-map in corner) and Figure 2 below (zoomed map).



Figure 2 Mini-map zoomed to maximum size

You will most likely need to reduce the level of detail from that shown in the full architectural drawings. See below for example showing stairs and core in design drawing (left) and mini-map (right).

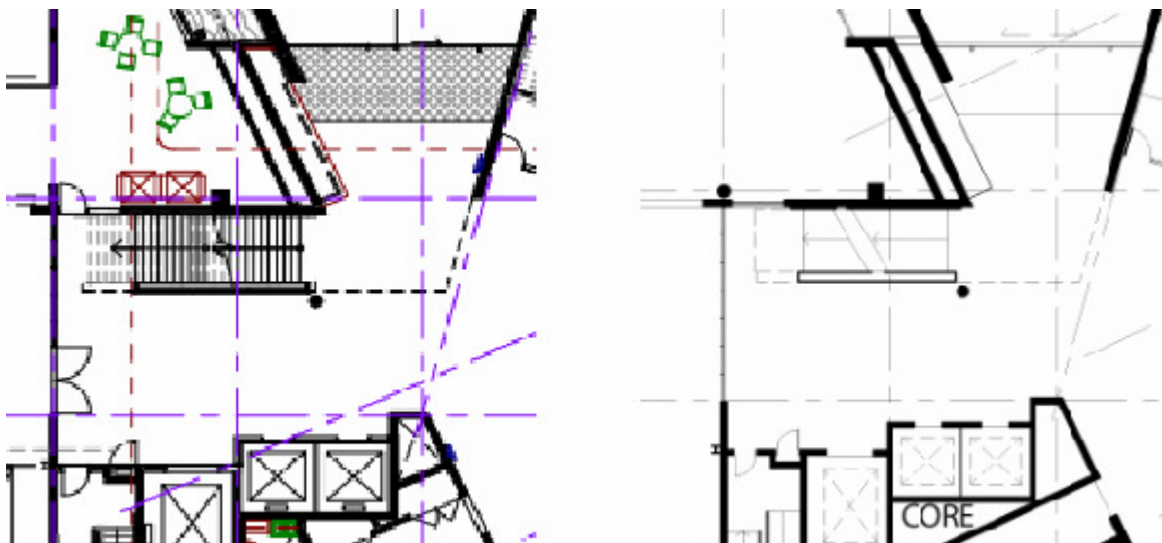


Figure 3 Comparison between Architectural design drawing (left) and Mini-map drafted view (right)

The scope of context around the subject project should also be considered. This may be helpful for users to orient themselves but should not impact legibility of the project building in the mini-map within the application.

### 1.2.2 Laying out

Note that nodes are not marked on/in the digital drawings to be loaded into the mini-map object in the 4D application. Rather, physical node coordinates are translated into a graphical overlay that allows user navigation by selecting (clicking on) node icons (see Section 2 below on nodes and coordinates).

To simplify plotting node locations, both physically and graphically, apply the same lay-out and scale to all the floor level plans to be used in the mini-map navigation tool. Include a structural grid (Cartesian), a scale bar and a north point.

### 1.3 Exporting

Mini-map drawings, one for each floor level surveyed, should be exported in 'PNG' format to the MiniMap folder for the site using the following naming convention:

Level0Plan.png

Plans should be exported at scale, and that scale should be communicated to the IT team implementing the 4D application (eLIPSE). Use the 'MinimapNodeSurveyData.xls' template (see also 2.3 Documenting survey nodes) to record and send the basic data needed for the mini-map object:

Floor\_level, x\_pixel\_offset, y\_pixel\_offset, x\_pixels\_per\_meter, y\_pixels\_per\_meter

Floor levels are numbered upward starting at ground level, which is usually labelled 0 (zero) but 1 (one) is also possible.

Use an image editing software (like GIMP) to establish the pixel values:

- X and Y pixel offsets denote the x and y distances in pixels between the top left of the plan image (canvas) and the reference point (origin) for the site co-ordinates. In principle, these values should be the same for each floor level plan.
- X and Y pixels per metre (measure scale bar) provide the conversion values used to position the node icons over the level plan in the mini-map. These values should also not change between floor level plans.

Save the spreadsheet file in the MiniMap folder, so that it will automatically travel with the mini-map drawings each time new or up-dated data are supplied for a 4D 'build'.



## 2 Node location and coordinate system

Nodes are the site locations at which panoramic photos will be/have been taken. Icons representing these nodes are over-laid on the mini-map graphical object to allow users to navigate through the 4D environment and view photos and documents correctly. To date, they have been represented in the 4D application with coloured dots on the mini-map (see figure 4).

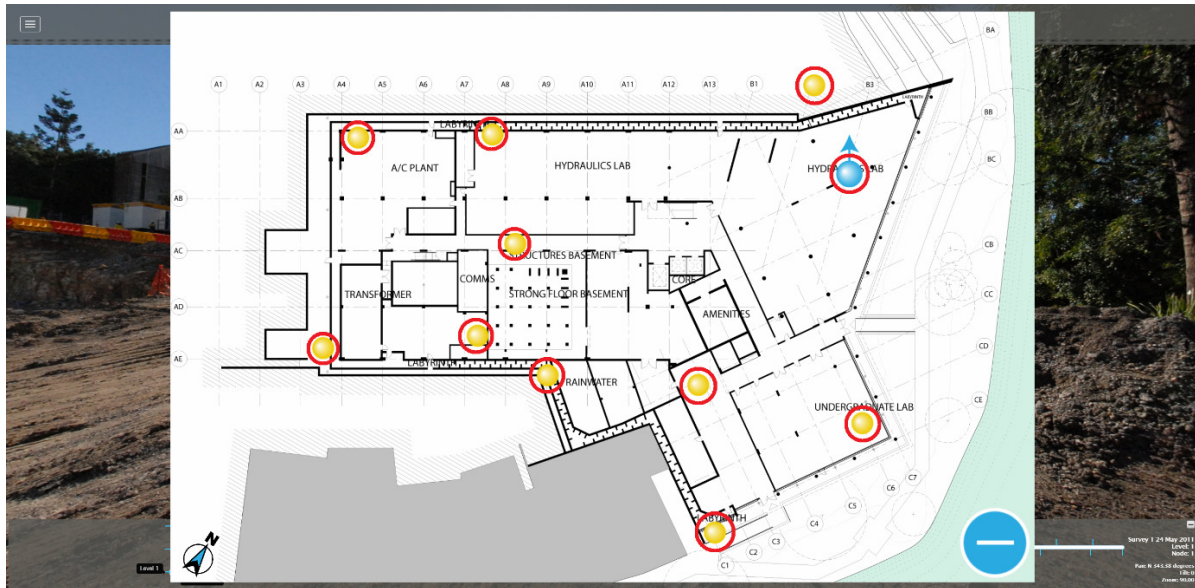


Figure 4 Nodes points marked with red circles. Active node in this example is blue.

Prior to beginning image collection on site, identify suitable Node locations on a plan drawing. These node locations should be accessible through most stages of construction and selected to maximise the usefulness of collected images for demonstrating the construction processes included in the 4D project's learning activity list.

### 2.1 Establish origin

The coordinate system used within the 4D application is a Cartesian grid. Node locations are identified based on their numerical X axis and Y axis values.

An origin, or zero point (0,0) needs to be established from which all other nodes can be located and named. This origin applies only to your 4D application project and does not need to relate to any official survey marker.

Any point on your mini-map plan could be used as an origin but the use of a structural grid intersection is recommended for simplicity and clarity. In Figure 5 below, the grid intersection of A1 and AA has been used. It is advisable to place your origin at a point that results in most coordinates being positive values, although negative values may occur.

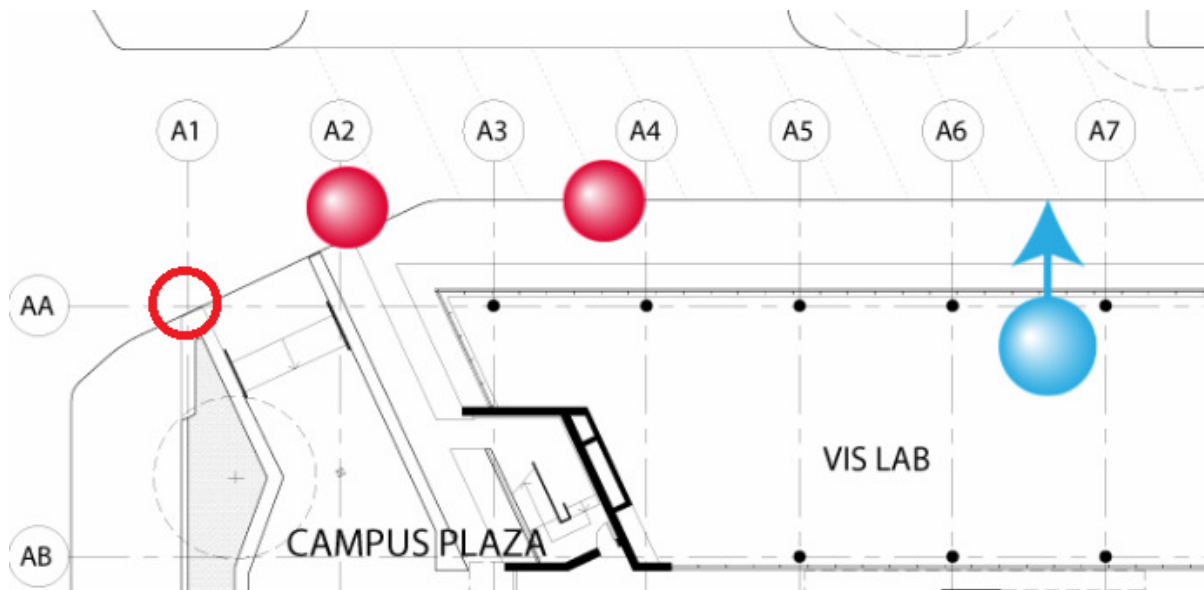


Figure 5 Selected origin (0,0) shown with red circle

## 2.2 Identifying and naming nodes

All nodes are named according to measurements from the project origin. The measurements are recorded in metres to one decimal place then drop the decimal (i.e. multiply by 10) when recording the node identity. Node names should not contain any decimal points in your project folder structure. See Figure 6 for an example of a node, with set-out measurements shown to identify node location.

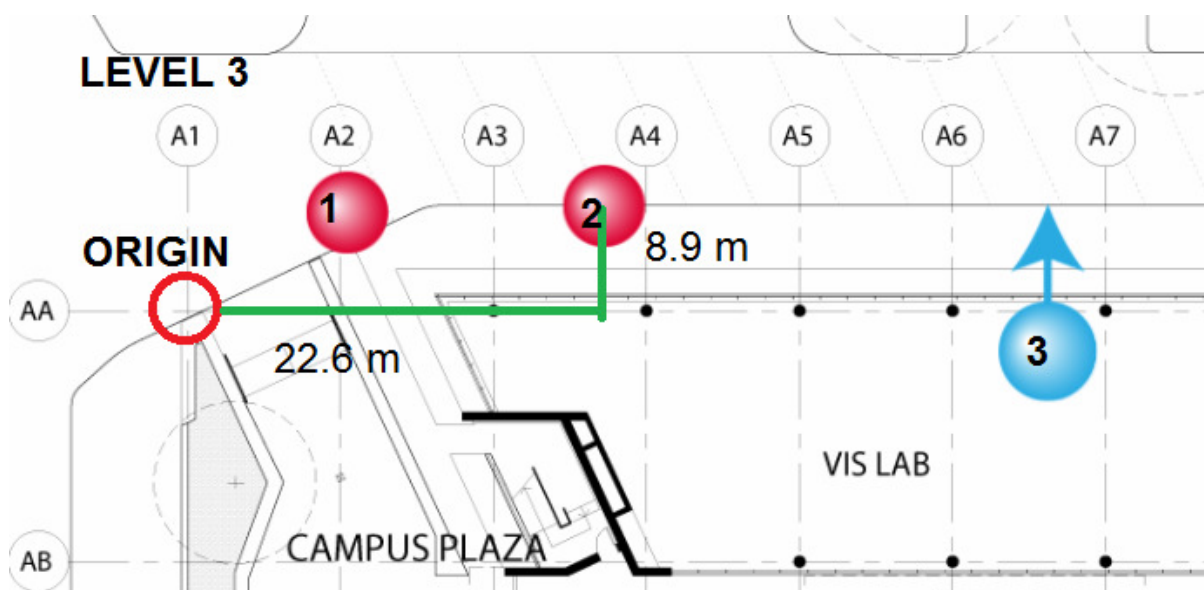


Figure 6 Node location using Cartesian coordinates.



In addition to coordinates, nodes are also identified by their floor level number within the project and their node number for that floor level. Use the following template for node names:

[floor level]\_[node number for level]\_[X coordinate in metres x10]\_[Y coordinate in metres x10]

Remember that the X and Y coordinates are recorded to one decimal place, then x10 to remove the decimal point. For example, in figure 6 above, Node 2 on Level 3 would be identified as

**03\_02\_226\_89**

As the template and example show, there should be no spaces or punctuation marks, other than underscore. The only exception is if dealing with negative coordinates, in which case use a leading minus sign (hyphen) with no spacing on either side (e.g. 01\_05\_210\_-174).

Node coordinates (X & Y) do not need to be pin-point accurate but they do need to be roughly correct to ensure that, when selected, the node location on the map will be appropriately reflected in the panoramic image associated with it. This will avoid confusion for users trying to understand the construction project, especially when unfamiliar with it.

### 2.3 Documenting survey nodes

Download the 'MinimapNodeSurveyData.xls' template to use initially in conjunction with planning node locations but definitely before starting the first survey photography.

This workbook is set up to help with:

- listing planned nodes with relevant data prior to surveying
- recording nodes planned and used in a survey
- documenting any 'new' or unplanned nodes arising during a survey because a planned node was unavailable
- checking survey and mini-map 'data quality' before exporting new surveys to the 4D application build process
- entering metre to pixel conversion values for mini-map drawings
- quick and easy export of the mini-map, survey and node data required to build and update your 4D application project.

Send a copy of the up-dated spreadsheet file to eLIPSE with each transfer of data for your 4D application build. The file can be saved in the MiniMap folder for zipping and shipping with floor level plan files for the minimap graphical object.