Theorem Understanding of the Recommended Practices for Model Viewing

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The recommended practice document refers to a number of different planar boxes in defining the relationships between the camera model and the drawing organisation. The step entity descriptions also introduce a number of different contexts – some of which are explicit step representation_contexts and some of which are not. (So step representation_contexts will be named RContexts and other contexts will be named Contexts).

This note defines our initial understanding of how these all fit together. However, we feel that there are some areas where the step definitions – or at least, our interpretation of the step definitions, are ambiguous. In particular, the diagrams for the projection boxes are not geometrically correct and are only diagrammatically correct for a specific case.

1) Camera model view

First, we have a model which is defined in a 3D representation_context (RContext A). See Fig. 1.

We wish to view this model using a camera_model.
The camera_model uses a view_reference_system which is a 3D axis definition in the context of the model (RContext A). Call this reference system Context B.

The camera_model also uses a view_volume which is defined in the view_reference_system ie in Context B.
The projection_point is defined in Context B rather than in the model space (RContext A).

The view_volume introduces the view_window which is a planar box defined on the view_plane which is a constant Z plane defined in Context B. Call this planar box PB1. See Fig. 2.

2) Presentation view

The presentation view is defined with its own 2D representation_context (RContext C). See Fig. 3.

The presentation view uses a camera_image to link to the camera usage which links to the camera model view.

The camera_image defines a planar box (PB2) into which the camera_usage view window is mapped (also described as the viewport). This defines a scale for x and y directions of the 2D view window (mapped into the 2D view port of RContext C).

The placement for the planar_box defining this view_port should be in the list of items of the presentation_view (stated in section 3.1.1) which places the planar box in Rcontext C.

3) Drawing View

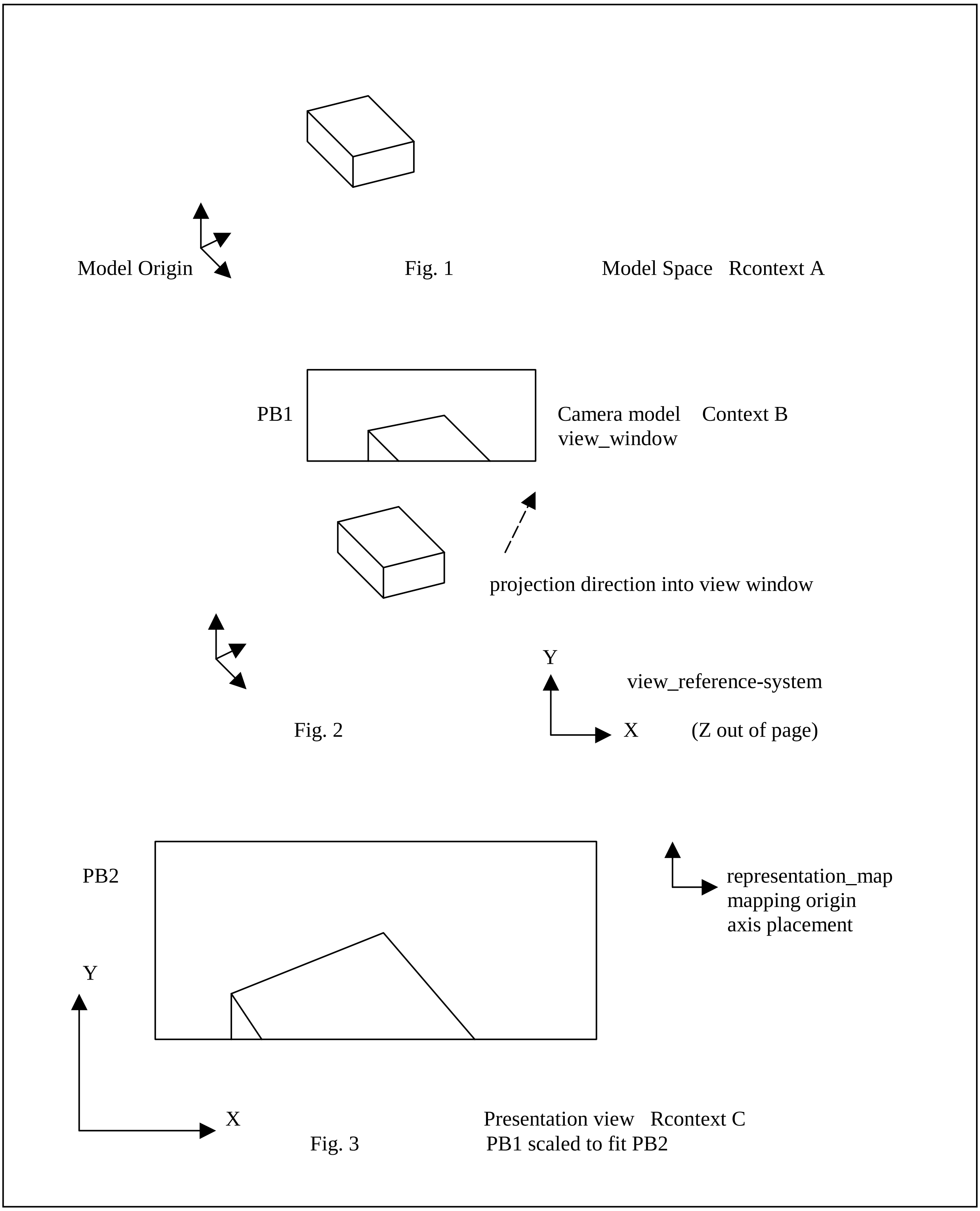
The view is placed on a drawing using a drawing_sheet_revision. This introduces another 2D representation_context (Rcontext D). See Fig. 4.

The size of the drawing_sheet is defined as another planar_box (PB3) which is linked to the d_s_r via a presentation_size entity. PB3 is defined within the context of Rcontext D and should be one of the items of the d_s_r.

The d_s_r items will also include the list of mapped_items which will allow presentation views to be placed on the drawing sheet plus the axis placements which are the targets for the mapped_items.

A mapped_item will map a presentation_view into the sheet. This will use an axis_placement which is defined in the context of the sheet (Rcontext D) and a representation map which will in turn use an axis_placement in the context of the presentation_view (Rcontext C). See Fig. 5.

Diagrammatically this all works like this



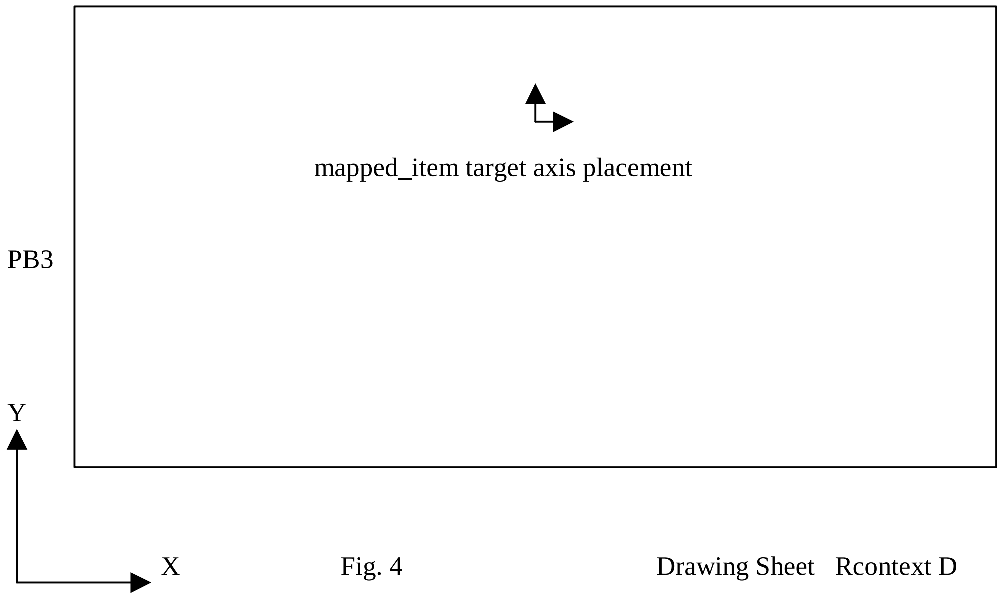


Fig. 4 Drawing Sheet Rcontext D

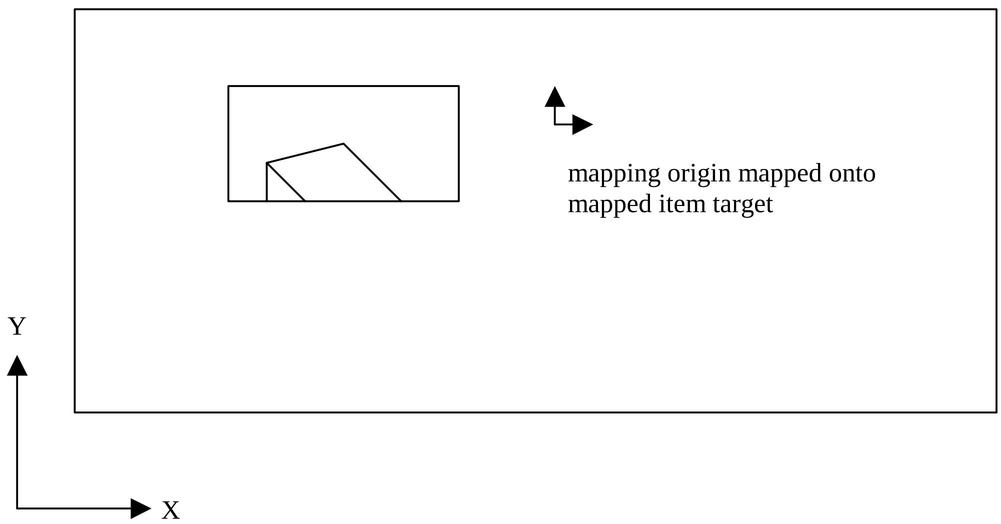


Fig. 5 Presentation view PB2 mapped into drawing sheet PB3

In terms of step entity linkage

The drawing_sheet_revision items list should contain the origin for the context, the mapped item and the planar_box PB3. The planar_box PB3 defines the size and position of the drawing in the context Rcontext D.

The mapped_item should link the/an axis_placement in the items list with a representation map which should link an axis_placement in presentation_view items list with the presentation_view itself.

This positions PB2 in PB3.   The scale of PB2 to PB3 is assumed 1:1

The presentation_view items list also contains a camera_image_3D_with_scale.which maps a camera_usage into the planar_box PB2.   The camera_usage defines a 3D viewing context (context B) within the model space (Rcontext A) and a view volume defined within Context B which incorporates clipping planes. The clipping planes in x-y of the context (Context B) are supplied via a planar box PB1 defined at a constant Z of the view_reference_system (at the view_plane_distance). The mapping of PB1 into PB2 implies a potential scale in X and Y.

Issues arising from our investigation.

1) The context for the planar box PB1 which defines the view_window.

The text defines / implies that the planar box is defined on the view plane which is a constant Z at a specified distance from the origin of the view_reference_system.   The implication is that the axis2_placement which is the origin of the planar box is a 2D placement and the X,Y co-ordinates are defined by the view_reference_system axis_placement.   However, this is not explicitly defined either in the text or in the express. Further, there is an issue as to the representation_context in which it is founded. The v_r_s defines a co-ordinate system relative to model space but does not define a representation_context. So, the 2D axis2_placement must be founded in the 3D model context. Is this allowed – or is this a similar conflict to that of 2D U-V curves defined in a 3D model context ?

This may be similar to the issue described in section 6.5 but is included in case it is a different issue.

2) The diagrams defining the projections lead to the impression that the projection directions are parallel to the Z axis of the VRS.

The diagrams are geometrically incorrect in that the (assumed) X-Y axes are displayed at right angles to each other whereas the (assumed) Z axis is displayed at an angle.

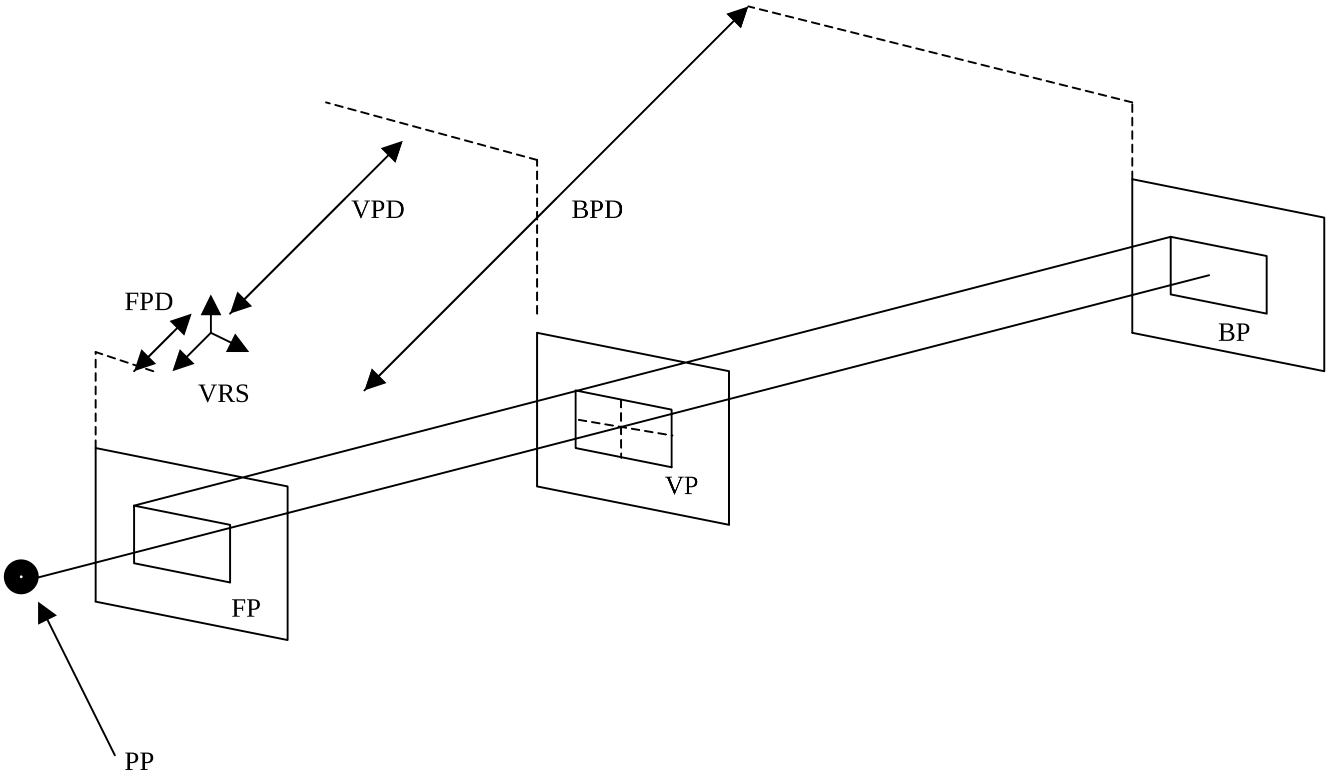
Similarly, all of the boxes are displayed as rectangular which would not be the case.

It is understood that diagramatically this allows the different planes to be displayed but is potentially confusing.

The second issue with the diagram is that is shows the projection direction as being parallel to the display lines for the various distances – view_front_distance, front_plane_distance etc. which are measured along the Z axis of the VRS.

The combination of these 2 issues lead us to an initial assumption that the projection direction would be parallel to the Z axis of the VRS – which is not in generally true. In the special case the view_volume would be a rectangular parallelepiped as displayed whereas in the general case the parallelepiped would be non rectangular (a trapezoidal parallelepiped ?).

This is our attempt at the general case for a parallel projection.



The view plane distance, the back plane distance and the front plane distance are measured from the VRS origin along the Z axis and may be positive or negative.

The view window is a planar box defined within the VRS at a distance VPD along the VRS Z axis and the origin has an x,y value defined by a 2D axis placement. The view window size is defined in x and y, assumed to be relative to VRS (but actually founded in Rcontext A).

The projection direction is from the projection point to the centre of the view window. Thus the projections of the view window onto the front plane and back plane are at different x,y positions.

The clipping planes (front and back) are at constant Z in VRS and are therefore angled to the projection direction so the top and bottom sections are trapezoidal.