Blender in architecture

• Everyone knows that blender is cool handling 3dviz/modelling jobs.
  • Some people use it for architecture even now!
  • Still.. there is space for improvement.
• Why it is (could be :) ) better than other tools in market?
CAD vs BIM

- CAD is about lines, solids and meshes. Out of date.

- BIM is about model in general. You describe the essence of the building. Blueprints should just pop out of it magically.
Building information modeling
Situation in market

• Still, *** A LOT *** of architects use old-school CAD here.

• Market demands BIM:
  • Better decisions
  • Greater predictability
  • Less conflicts and collisions
  • Faster project delivery
  • Better project maintainability through all lifecycle
PLUS

• Augmented reality:
• Ability to see through the wall – pipes, electricity cables etc with iphone
• Easier construction & maintainance
Big four

• Autodesk Revit
• Autodesk Architectural Desktop
• Graphisoft ArchiCAD
• Bentley Systems
Competetetiviness

• Power of open source!

• Big projects repetetive jobs costs could be cut by customising software – API's available for closed-source projects don't always work out

• Better competition for training, support and developement service providers
Leaps and bounds

- Lack of tools & special functionality
  - not too hard to solve!
  - details in our feasibility study

- It's worth to color the gray area between CAD/Modelling and 3DViz -to have everything in one box
If talking about BIM...

• Real things are made from objects. Not lines. Not polygons.

• It has to be possible to customize the object without re-designing it completely.

• In example, change height of the table by modifying height parameter.
Basic parameters

<table>
<thead>
<tr>
<th>Component</th>
<th>Info</th>
</tr>
</thead>
<tbody>
<tr>
<td>Category</td>
<td>Furniture</td>
</tr>
<tr>
<td>Name</td>
<td>Table</td>
</tr>
</tbody>
</table>
How is this possible?

- Reference planes (Refplanes). They are everywhere.
We have a object. Actually, we have a table.
Refplanes

Let's add it a surface and floor level Refplanes. It will be possible to lock it to other objects (in example, room floor).
Locking geometry to Refplanes
Locking geometry to Refplanes

You can lock object parts to refplane. For example, desk surface to desk surface refplane.

Or leg ends to the floor level Refplane.
Adding parameters

Then, it is possible to add parameters between refplanes. Let's specify table legs height for instance.
Geometry changes according parameter values

Then, when we have instance of the object, our new parameter appears in Object properties box.
Geometry changes according parameter values

We change it, and table becomes lower.
Geometry changes according parameter values
Controls

Another way to change parameter values
Controls

Let's add some more refplanes

Desk surface

Height

Level

Width
Controls

And objects defining which refplane user could drag
So even if we exited edid parametric component mode we can drag now hidden refplanes
Controls
Controls

Table

Level | Level 1
---- | ----

Level offset | 0

Spatial

Width | 1330
---- | ----

Depth | 800
---- | ----

Height | 750
---- | ----
Controls
Controls
Controls

Table

hosts

Level | Level 1
--- | ---
Level offset | 0

Spatial

Width | 630
--- | ---
Depth | 800
Height | 600
Very complex situations

• There is nothing that couldn't be programmed by Python on the Parametric Model side

• Powerful API of POs to be developed
Refplanes and hosted components
Refplanes and hosted components

Also refplanes can be used to snap object to parent level refplane.
Refplanes and hosted components

Level 1

Level 2

Component

Table

Hosts

Level

Level offset

Spatial

Width

Depth

Height

Level 2

0

200

300

850
Refplanes and hosted components

You just change hosting parameter value, and object appears in another floor Offset allows table to levitate :-)}
Refplanes and hosted components
Refplanes and hosted components

Desk surface
Refplanes and hosted components

Desk surface

Desk surface
Offset from host refplane
Offset from host refplane
Adaptive components

Sometimes it is required to have components that automatically expands in desired space, delimited by desired refplanes.
Adaptive components

This example allows to calculate room volume. Or to specify a purpose for the area. Living room, kitchen, lounge, etc...
Adaptive components

Level 1

Wall surface

Component

Space

Hosts

Level

Constrains

Top

Bottom

Side

Ceiling surface

Floor surface

Wall surface
Adaptive components

Room 2

Wall surface

Level 1

Wall surface
Adaptive components

In this example (plan view), we calculate area of floors by counting room components and showing them in schedule. Schedule column shows area parameter value of room components.
Adaptive components

If we move wall, room component automatically extends to fill new space. Area parameter updates.
Adaptive components

Ceiling surface

Wall surface

Floor surface

Section A

Component

Plaster

Constrains

Side: Wall surface

Spatial

Thickness: 100

Appearance

Material: Plaster
Adaptive components

This tool can be also used to add some materials onto all walls, for instance, plaster or paint.
Adaptive components
Adaptive components

Example of applying some plaster to the wall.
Refplane and adaptive components benefits to mainstream version of Blender

- Optimized workflow
- Increased flexibility
- Automatic object resizes, placements, etc.
- More generalized, less repeating objects
- Adaptive components saves time and hassle
To make drawings display actual information, it is vital to have the ability to draw dimensions for some important distances, angles or altitudes.
This 2D component displays particular parameter value of another component.
Tag

1200 x 600

Component
Table
Hosts
Level | Level 1
Level offset | 0
Spatial
Width | 1200
Depth | 600
Height | 750
Changing value in Tag also changes the tagged component parameter value.
Changing value in Tag also change tagged component parameter value
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Even if we start nanolathing directly from the project model one day, still, drawings are at least interesting to print out.
View creation

Section A

Section B

Level 1

Level 2

Project

Schedules
- Chair schedule

Floor plans
- Level 1
- Level 2

Sections
- Section A
- Section B
View creation

- Level 1
- Section A
- Section B

- Project
  - Schedules
    - Chair schedule
  - Floor plans
    - Level 1
    - Level 2
  - Sections
    - Section A
    - Section B
View creation

Level 1

Section A

Section B

Project
  - Schedules
    - Chair schedule
  - Floor plans
    - Level 1
    - Level 2
  - Sections
    - Section A
    - Section B
Model space

...When you click on a page or spread in project tree, you get special interface to organize the 2D drawings.
Paper space
Views added to sheets

Project
  Schedules
    Chair schedule
  Floor plans
    Level 1
      Level 2
  Sections
    Section A
    Section B

Diagram:

- Section A
- Level 1

Table:
<table>
<thead>
<tr>
<th>Project Name</th>
<th>Sheet Name</th>
<th>Date</th>
<th>Scale</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Floor plan 1</td>
<td></td>
<td>M 1:100</td>
</tr>
</tbody>
</table>
Views added to sheets

<table>
<thead>
<tr>
<th>Project Name</th>
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<td></td>
<td></td>
<td>M 1:100</td>
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</table>
Exporting spreads to PDF
Exporting spreads to PDF
Layout engine benefits to mainstream version of Blender

- Suitable as a documentation tool.
Online parametric component library
Important

- Connection between online library and local project
- Version & updates control
- Teamwork & project workflow management
- Use cases:
  - Real-life 3D model gallery/database
  - Intranet for developing complex projects
Online parametric component library
Online parametric component library
Online parametric component library
Online parametric component library

When we open old model and Blender sees updates online, it is possible to update to new version with one click.
Online parametric component library

- Library acts like Linux package repository
- Parametric components are like packages
- One module can have a loads of requirements, version dependencies etc...
Problem of consistency

• Like in coding, it is very important, that everyone would create models and name refplanes using determined names.

• Imagine, if someone starts naming floor as „Bottom“, and other - „Level“, tables made to snap level „Floor“ will not work on any of these.

• Strict control is compulsory, as like in accepting code to mainstream!
Tools to manage consistency of components

- Standard templates
- Validators
Chair geometry
Chair template
Template added to geometry
Geometry locked to refplanes
Geometry locked to refplanes
Scope boxes

House A
Scope boxes

Room 2
Scope boxes

House A

Room 1

Room 2

- Component
  - Location
    - Room 1, House A

- Component
  - Location
    - Room 2, House A
Objects sorted by scope box parameter

**Room 1**

<table>
<thead>
<tr>
<th>Name</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chair</td>
<td>2</td>
</tr>
<tr>
<td>Table</td>
<td>1</td>
</tr>
</tbody>
</table>

**House A**

<table>
<thead>
<tr>
<th>Name</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chair</td>
<td>2</td>
</tr>
<tr>
<td>Table</td>
<td>1</td>
</tr>
<tr>
<td>Bed</td>
<td>1</td>
</tr>
<tr>
<td>Lamp</td>
<td>1</td>
</tr>
</tbody>
</table>
Beating performance bottlenecks

Complex model = slow user experience

Possible solutions:

➔ Use appropriate hardware :-)  
  ✗ It's expensive

➔ Distribute expensive calculations over the cloud  
  ✗ Won't scale in some cases; Works only for final rendering

➔ Strict Level of Detail  
  ➔ We don't see screws of the windows anyway :-)
Automatic Level of Detail

• Has to be automatically managed when working with models;

• Flexibility to customize component priority / rules of LoD is a must when creating PO

• Profit for the mainstream version is obvious! (faster work with complex objects)
Complex commercial formats

- No documentation
- Closed-source projects poorly support other closed-source formats
- Errors and data fidelity losses are common
.ifc (Industry Foundation Classes)

- Intended to describe building and construction industry data
- neutral and open specification
- not controlled by a single vendor or group of vendors

- well-known standard in architectural design field
- Still.. Commercial software doesn't export/import this format very well
Thank You for attention!

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