

3D Printable Dubrovnik Style Chess Set

Designed by [Conor O’Kane](#).

Table of Contents

| | |
|------------------------------|----|
| Print Settings..... | 2 |
| PLA..... | 2 |
| Woodfil PLA..... | 3 |
| Supports..... | 5 |
| Staining..... | 7 |
| Sealing..... | 8 |
| Weights..... | 9 |
| Filling the base..... | 10 |
| Adding felt..... | 11 |
| Video demonstration..... | 12 |
| Selecting a chess board..... | 12 |
| STL Files..... | 13 |
| Materials list..... | 14 |

Print Settings

These print settings were used to print the pieces seen in the photographs below. They were printed on a Wanhao Duplicator i3 V2. You may need to adjust the settings slightly to get the best results from your printer.

PLA

| | |
|--------------------------|----------------------------|
| Basic settings | |
| Layer Height | 0.2mm |
| Top layers | 4 |
| Bottom layers | 3 |
| Outline/Perimeter shells | 2 |
| Outline direction | Inside-out |
| Raft | No |
| Support | No (except for the knight) |
| Infill | 15% rectilinear pattern |
| Extruder temperature | 215°C |
| Bed temperature | 60°C |
| Advanced settings | |
| First layer height | 90% |
| First layer speed | 50% |
| Print speed | 60mm/s |
| Start points | Randomised |



An important factor in getting a smooth finish on your pieces is to randomise the start points for each layer. In Simplify 3D this setting is in the FFF settings, layer tab. Random start points ensures that oscillations caused by your printer do not repeat vertically along the model. This slightly increases the print time but results in much smoother vertical surfaces.

Woodfil PLA

These settings are for bamboo woodfil PLA. I used [this filament](#) from [Blueprinted.co](#). Settings that are different from standard PLA are highlighted in bold.

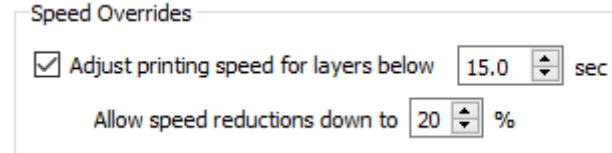
| | |
|--------------------------|----------------------------|
| Basic settings | |
| Layer Height | 0.2mm |
| Top layers | 4 |
| Bottom layers | 3 |
| Outline/Perimeter shells | 2 |
| Outline direction | Inside-out |
| Raft | No |
| Support | No (except for the knight) |
| Infill | 15% rectilinear pattern |
| Extruder temperature | 200°C |
| Bed temperature | 50°C |
| Advanced settings | |
| First layer height | 90% |
| First layer speed | 50% |
| Print speed | 50mm/s |
| Start points | Randomised |



As with regular PLA – randomised start points are critical to ensuring a good finish.

I also used the following speed override when printing these pieces:

In Simplify3D this can be found in the Cooling tab. This setting slows down your print if a layer would take less than 15 seconds to complete. As the print head moves up the piece the diameter of the

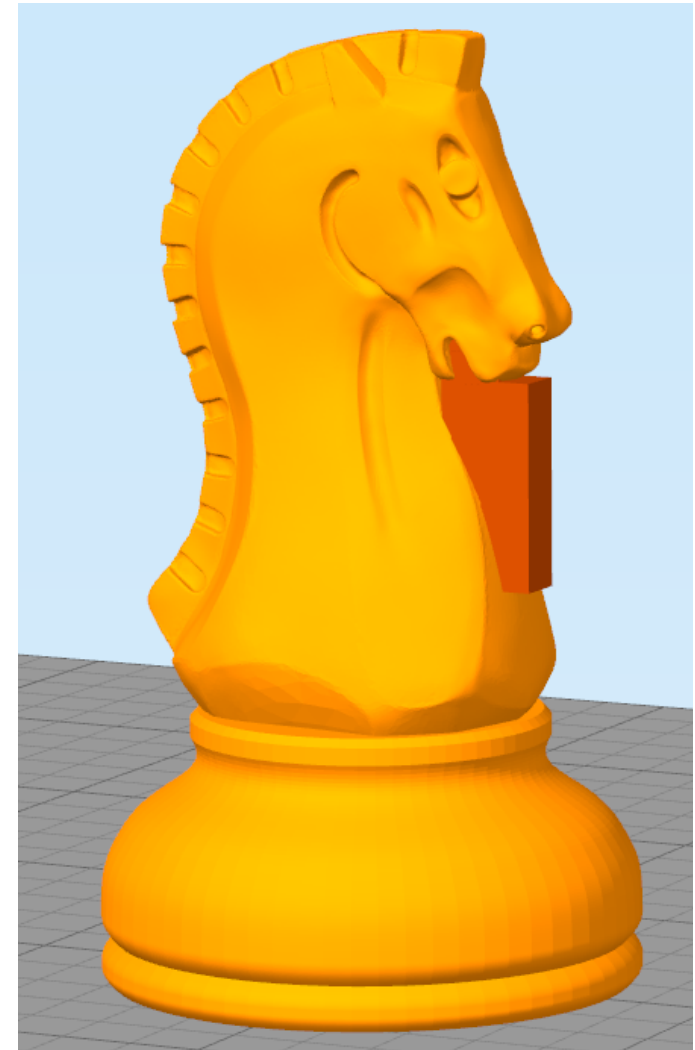
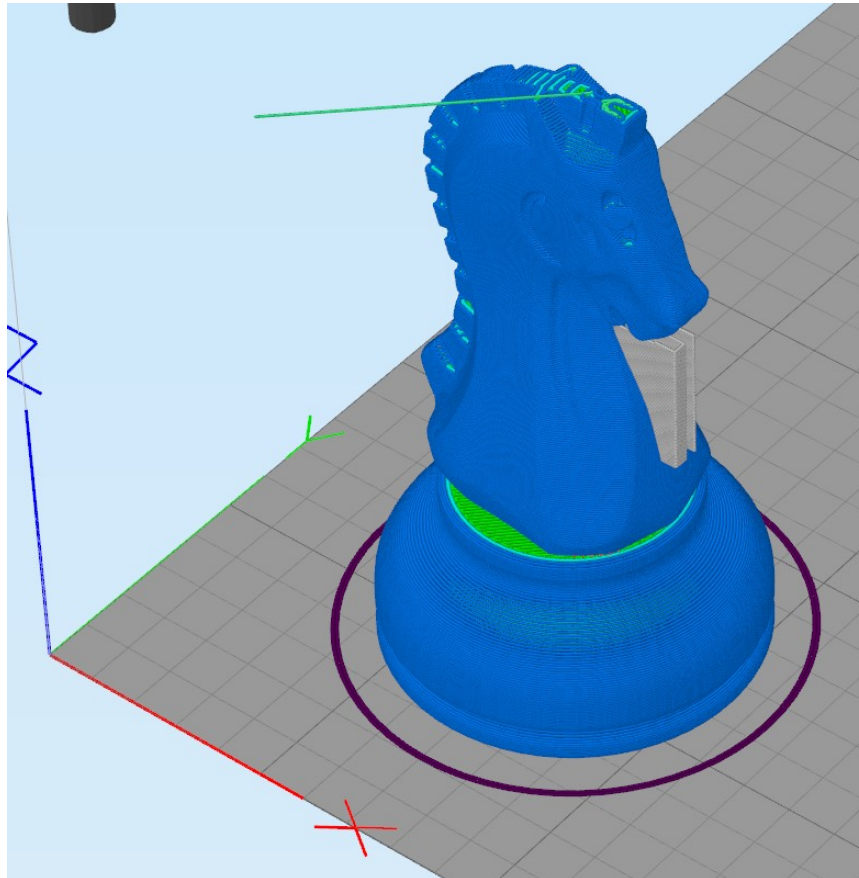


model decreases meaning it is printed quicker, however if a layer is completed too quickly it will not fully cool before the next layer is deposited on top of it. This can result in irregular looking spheres on the tops of the models. To correct this you must slow your print speed down using the speed override shown above, or print multiple models at once, which increases the layer print time.

Note however that when printing multiple models the print head will be jumping long distances between the models as they reach their tops, so you may need to increase retraction settings to prevent blobs appearing.

Supports

The knight piece requires supports under its nose. In the image on the right, the orange areas show where supports are needed. If you are slicing with Simplify3D you can open the support tool and add supports in this area. It is recommended that the knight be orientated facing right (along the printer's X axis) if using Simplify3D supports as this will align the supports with the piece such that the contact area is minimal. So when the supports are removed they will not leave any marks on the surface. The ideal alignment is shown in the image below.



Here you can see what the supports should look like when printed, and on the right the supports have been removed and there is almost no marking on the knights surface.



None of the other pieces require any supports.

Staining

If you print your set in woodfil PLA filament you can use wood stain to darken the black pieces. Ideally you should print all the black pieces so you can stain them together, to keep the color consistent. Remember to print an extra queen for promoted pawns.

The pieces in the image on the right are stained with Rosewood stain, but any dark wood stain will work. To prepare the pieces, mount them on sticks using Blu Tack so that you can paint them without leaving finger-prints. Polystyrene or foam blocks make useful mounting boards to hold the pieces on their sticks while they dry. Using an old brush, apply a thin coat of stain over the piece. Make sure the stain does not pool in the crevices – it will take three or four coats to darken the pieces sufficiently so avoid pooling as this will be greatly exaggerated as more coats are applied. Remember to leave the finials on the black bishops unstained and to color the finials on the white bishops if you wish to achieve an authentic Dubrovnik style.

In this image the middle pieces have had one coat of stain, and the pieces on the right have had four. Allow the pieces to dry for at least 24 hours before applying the next coat.

Use white-spirit or turpentine to clean the brush after use. Do not allow the stain to dry on the brush.



Sealing

Once the final coat of wood-stain has dried you may find the pieces still have a sticky surface. If this is the case, or if you just want a glossy finish then seal your pieces with varnish. You will need an oil-based gloss spray varnish like the one shown below (British Paints oil-based exterior varnish). As with the staining, multiple thin coats are preferred. If too much varnish is applied in one coat it will pool and appear yellowish. If you find the varnish is pooling, quickly blot off the excess with a tissue. Cover the bishops' finials with masking tape to prevent the spray from hitting them. Allow at least 8 hours between varnish coats. The pieces shown below had two coats of gloss varnish applied.

Once the varnish has dried the pieces will feel smooth and should have no stickiness.



Weights

The bases of these pieces are hollow, both to speed up print time and to hold weights. A hot-glue gun is ideal for attaching metal weights inside the pieces. For weights of around 15g you can add an M12 hex nut inside the bases. For heavier pieces, insert a 14mm diameter ball-bearing first and then an M12 hex nut on top – this will weigh around 32g. If you have lead weights these can be used to make even heavier pieces.



Filling the base

To seal the bases and prepare them for felt, spread some spackling paste such as Polyfilla or any typical water-based household filler over the hole with a spatula or stick. To get a smooth finish add a little water to your mix and scrape along the base to remove any excess filler and create a flat surface.



Adding felt

Sheets of felt can be purchased in dressmaking stores. Wait at least 24 hours for the filler to dry. Press the filler with your fingernail – if it leaves a mark then you need to wait longer. The PVA glue used to attach the felt will create an airtight layer over the filler, so it's important that the filler has fully hardened before proceeding.

Cut pieces of felt bigger than the base you're covering and glue them in place using PVA glue (also called kids glue or wood-glue). Spread a thin layer of PVA glue over the entire base and then press the piece firmly down onto the felt so that the glue soaks into the felt. Allow one day for the glue to dry. Ideally the pieces should be inverted while drying so that the air can reach the base, allowing the glue to dry thoroughly.

Once the glue is dry cut closely around the base with sharp scissors to remove the excess felt.

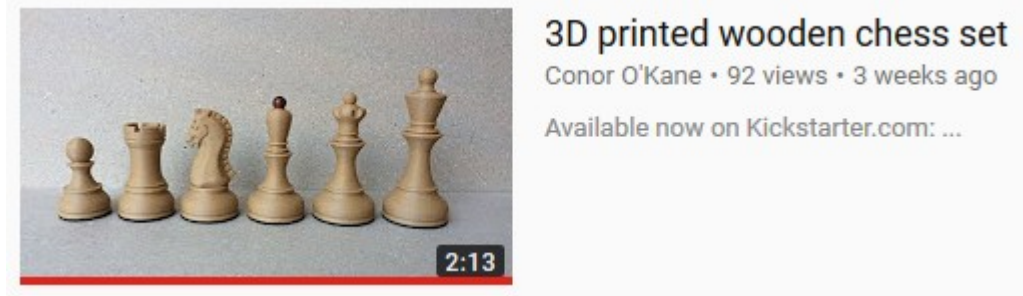


Try to angle the scissors so that they cut the felt at 45 degrees, this way the felt will not protrude out beyond the edge of the piece's base.



Video demonstration

Many of the techniques shown in this guide can be seen in more detail in this YouTube video:











Selecting a chess board

When printed at 100% scale these pieces look best on a chess board with two inch squares, as shown in this image. If you have a larger chess board then print the pieces at a larger scale – this will not require any changes to the print settings. Printing at a smaller scale may require that the print speed be slower as the small details on the tops of some pieces will require additional time to cool.











STL Files

The following files are contained in the Zip download:

-  Bishop.STL
-  Bishop_base.STL
-  Bishop_finial.STL
-  King.STL
-  Knight.STL
-  Pawn.STL
-  Queen.STL
-  Rook.STL

The bishop can be printed as one piece (Bishop.STL) for painting the finials or in two parts if you wish to use two different colored materials (Bishop_base.STL and Bishop_finial.STL). Stretch goal variations are found in the /Variations folder:

-  Bishop_Dubrovnik_I_style.STL
-  Bishop_Dubrovnik_I_style_base.STL
-  Bishop_Dubrovnik_I_style_finial.STL
-  Bishop_split_hat.STL
-  King_zagreb_style_base.STL
-  King_zagreb_style_finial.STL
-  Queen_zagreb_style_base.STL
-  Queen_zagreb_style_finial.STL

Materials list

Here is the list of materials and tools used to make the sets shown in this guide.

- Bamboo 'woodfil' PLA filament
- Rosewood wood-stain and an old paint brush
- Blu Tack, wooden skewers and foam blocks to hold the pieces while staining and varnishing
- Turpentine or white-spirit to clean the brush
- Oil based gloss varnish spray
- Masking tape to mask the bishops when varnishing
- Hot glue gun (for attaching weights) and two or three sticks of glue
- M12 hex nuts (and optionally 14mm steel bearings) for weights
- Filler such as Polyfilla or Spackle
- One A4 sheet of felt
- PVA glue

I hope you enjoy making and playing with your chess set – if you have any comments or need assistance with printing you can contact me at cokane@cokane.com

Conor O'Kane

Melbourne, December 2017