

Perfect, parametric bricks!

VanessaE

VIEW IN BROWSER

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Summary

Parametric brick and beam generators, plus a selection of gears and related, compatible with LEGO, Tyco, Mega-Blok...

Toys & Games > Building Toys

This project implements a fully-parametric brick/plate/tile generator, and a parametric modern liftarm/beam generator in Blender, creating parts that work with LEGO, Tyco, Mega-Bloks, and other compatible interlocking construction toys. In addition to a representative (but by no means exhaustive) selection of bricks and plates and such, you'll also find tons of gears, beams/liftarms, and other Technic parts.

Every important parameter or dimension can be adjusted - brick wall thickness, stud diameter, axle dimensions, pin hole diameter, and a whole lot more. Many parameters are global and affect all parts within the project file which use those parameters, and most parts across the project have a number of “local” settings of their own, as well (which is how you set things like a brick's dimensions, whether it's round, has holes, etc).

This project is split into five separate Blender files - brick generator, beam generator, special bricks/plates, gears, and misc. Technic parts. This last one also contains the gears that bear clutches (since they spin freely on an axle, and thus mostly can't be used as conventional gears).

Simply load the brick generator project, select the orange brick shown there, or load the beam generator and select one of the beams shown (it's a good idea to start with the plain 5L beam), change its parameters in the “N” Sidebar (or in the “Object Properties” tab), and in the World Properties tab, and export the result to a new model file.

The gears and axles are similar, though like the beams, they have only a few global and per-part options, since they have far less variability than a brick or plate. The “other” and “special” files are similarly-limited, mostly only responding to things like stud and wall dimensions and such.

There is also a simple bracket generator in the “special bricks” workfile, and a steering link generator in the “other technic parts” workfile.

Note that due to limitations in Blender, World Properties are not (and cannot be) shared between these project files, so you'll need to make sure that any settings changes you make in one project file, you also make to the others, if needed, for the sake of consistency. Sorry about that. If this can be improved, I'll do so.

Printing Settings

All parts are printable with 0.2 mm layers and the usual 0.4 mm nozzle, though I recommend using 0.1 mm layers when printing axles and the parts that have horizontal holes (classic Technic studded beams and the turntable at present).

You will need to use thin wall mode on some parts. The Arachne perimeter generator should work too, if your slicer has that feature.

Technic pins are printed vertically, which can make them fragile if you have layer adhesion problems, but there's really no other way to make those pins look and perform right. To mitigate this issue, use your best filaments (Atomic PETG is recommended), and print those parts slow and hot, with as little fan as you can get away with.

For every item that would need supports, I have provided custom support objects and have exported STL files both with and without them built in. This way you can just have your slicer create its own supports (SLA/resin users might prefer Meshmixer-style tree supports, for example). Or, if you're using an SLS machine, you just don't need any supports at all, since the powder does that for you.

Note that some parts are supposed to have little teeth around their pin hole(s). Throughout this project, I refer to these as splines, named for the axial cuts in a shaft that lock it radially to the receptacle it fits into, as in the CV joints or drive shaft of a car.

A resin or SLS printer should be able to easily print clean, strong splines with proper dimensions, but FDM printers are another story. An FDM printer with a 0.4 mm nozzle can successfully print them, but due to the amounts of cooling needed to get their shapes right, the layer bonding will probably be too weak, and unless you have a smaller nozzle, they will not be very precise. This is doubly true for plates, which have the splines facing the printer's bed/build plate (if you have any elephant's foot at all, it'll ruin them). I have printed them once during prototyping, and I even managed with some effort to press them into the splines of a commercially-made part, but I don't think I would try to use the result in an actual build.

That being the case, all parts that normally have splines have a setting to turn them off, and I've provided model files rendered with them and files rendered without them. If two parts in an actual build would need to join via those splines, it's probably best to turn the splines off, boolean the two parts into one, and print them as one piece. Or, you could print them with the splines, trim some of them off with a knife until the parts mate together okay, and glue them together.

Obviously, the various tires need to be printed in TPU or a similar flexible material. These models assume you're using something around 95A hardness, but softer should be fine too.

The two big Technic tires have support objects, and when it comes to TPU, supports can be weird, since TPU has insane layer bonding. In each case, there's a 0.4 mm gap between the supports and the tires' edges being supported, but you'll still probably need to turn the print temperature down and crank the crap out of the part fan on bridging moves, to reduce the adhesion between the tires and their supports (I actually had to tear the supports off of my prints).

The wheel rims for those tires need some special consideration as well: use more perimeters in the areas of the ridges that sit on the supports (so that they don't need zig-zag bridging infill), and a finer layer height might not hurt.

But you know what, you can mostly not worry about that. I've included .3mf project files made in SuperSlicer that are set up to produce a really nice prints of those rims, including those perimeter adjustments, settings to make the support objects behave more like auto-generated support, layer height changes to bring out the details in the front of the medium racing rim's spokes, and a bit more.

Sources

These models are not in any way derived from anyone else's works, neither commercial nor free, though I did make use of the LDraw library for some rough references, and took plenty of measurements of parts I have on hand, along with plenty of web searching to find the details I needed.

These models are entirely my own work, though I did use the Precision Gears Lite add-on to model the gears. If you want to alter any of them, you can get that add-on from https://makertales.gumroad.com/l/PrecisionGearsLite .

Pre-rendered Parts Included

There is a whole boatload of pre-rendered parts included in the project, in the usual STL format. These were rendered using settings that are appropriate for my printer, which I consider to be reasonably well-tuned.

Before just randomly printing stuff, start with the modern 5L Technic beam, the 4L classic beam/brick, and the standard 4x2 brick. If your prints don't snap together properly, first consider whether your slicer, firmware, and machine are all properly-calibrated before you start tweaking/re-exporting parts (or generating new ones).

Bricks, plates, and tiles:

- Standard 4x2 , 4x1, and 2x1 bricks, plates, and tiles
- Standard 2x2 round brick/cylinder and 2x2 round plate (#3941 and 4032)
- Standard 1x1 round brick/cylinder, with and without open stud (#3062 a/b)
- Standard 1x1 round plate, with and without open stud (#4073 and 85861)
- Standard 1x1 round tile (#98138)
- Almost-standard 4x4 round brick and 4x4 round plate (similar to #87081 and 60474 but without the extra holes and cuts)
- 4x2, 2x2, 3x1, and 2x1 “jumper” plates (#65509, 87580, 34103, 3794)
- Standard panels in several sizes: 4x1, 3x1, 2x1, 2x1 with center divide, 2x1 with uprights on three sides, 2x2 corner, 1x1 corner (#6231, 4865, 23969, 93095, 23950, 30413, 91501)
- Several plates with those clips meant to grab horizontal or vertical 3mm posts: 1x1 horizontal, 1x1 vertical, 2x1 horizontal (clip on end), 2x1 vertical (clip on end), 2x1 double horizontal (on side). (#4085, 61252, 6019, 60470, 63868, 78256)
- Three kinds of bricks with clips: 1x1 vertical, 2x1 vertical, and 1x1/3-high double vertical (#60476, 30241, 60583)

- 2x2 and 4x4 corner bricks (that is, the L-shaped bricks that are basically a square missing one quarter; #2357 and #702)
- 2x1 tile with grille cut pattern (#2412)
- 2x1 hinged brick (horizontal pivot, #3937/3938)
- 4x1/2x2 hinged “swivel” brick (#3830/3831)
- 4x1/2x2 hinged "swivel" plate (#2429/2430)
- Classic “Vehicle roof” hinged plate (#4213/4315)
- Classic 5x1/two-part 2x1 hinged plate (#4275/4276)
- Standard 1x1 + 1x1 bracket, both normal orientation and inverted orientation (#36841, 36840)
- Standard 1x1 + 1x2 bracket with vertical front, normal and inverted (#79389, 73825)
- Standard 2x1 + 2x1 bracket, normal and inverted (#99781, 99780)
- Standard 2x1 + 2x2 bracket, normal and inverted (#44728, 99207)
- Standard 2x1 + 4x1 bracket (#2436)
- Standard 2x1 + 4x2 bracket (#93274)
- Standard 6x2 + 6x1 bracket, inverted (#64570)

Technic:

- Three 5L modern beams (standard #32316, half-thick #32017, half-thick with end axle holes #11478)
- A modern 11L beam with alternating horizontal/vertical holes (#73507)
- Modern angled liftarms, one is the 6-4 size with a 53.13° bend (#6629), the other is 5-3 size with a 90° bend (#32526)
- A “modified stud connector” (4L half-thick beam with end axle holes, one end is fat, #2825)
- Liftarm/beam frames in 5x7, 7x11, and 11x15 sizes (#64179, 39794, 39790)
- Two types of 5x3 triangle liftarms (#2905 and 99773)
- 4L, 6L, and 8L classic studded beam bricks with horizontal holes (#3701, 3894, 3702)
- 4x2, 6x2, and 8x2 plates with holes (#3709, 32001, 3738)
- 8x1 plate with round ends and end holes, both with and without splines (#4442)
- 5x1 plate with round ends, end holes, and central axle hole, both with and without splines (#2711)
- 2L axle with notches (#32062)
- 4L standard axle (#3705)
- 2L (old-style) transmission driving ring (#6539, mates with the clutch-bearing gears above)
- Axle joiners, with and without ridges for the driving ring (#6538a and 6538c)
- Full-size standard axle bushing, with stud flanges (#3713)

- Half-size axle bushing, with and without splines, two axle hole types (#4265a/b/c)
- Three types of pulleys (large “steering” #3736, small “wedge belt wheel” #4185, and classic 9v motor pulley #2983)
- Standard 16x16, 32x32, and 48x48 base plates (#3867, 3811, and 4186)
- Technic pin with friction, standard length (#2780)
- Technic pin with friction, long/3L (#6558)
- Technic pin with friction, with tow ball (#6628)
- Technic pin without friction, standard (#3673)
- Technic pin without friction, with axle on one end (#3749)
- Technic pin without friction, long/3L (#32556)
- Technic pin without friction, long, with end stop (#77765)
- Several sizes of belts for pulleys: 16, 24, 32, 40, and 56 mm diameter (approximately equivalent to #70902, 71321, 70904, 70905, and 71059)
- Technic 1L axle with tow ball (#2736)
- Technic 2L and 3L (two pin holes) axle-to-pin perpendicular connectors (#6536, 42003)
- Technic pin/steering link, 6L (#2739b)

Gears and gear-like:

- 8-tooth (#10928)
- 12-tooth single-bevel (#6589)
- 12-tooth double-bevel (#32270)
- 14-tooth bevel, thin (#4143)
- 16-tooth, both old and reinforced variants (#4019 and 94925)
- 20 tooth (#69779)
- 20-tooth single-bevel (#32198)
- 20-tooth double-bevel (#32269)
- 24-tooth both the old 3-axle-hole version and the newer 1-hole version (#x187 and #3648)
- 24-tooth crown, reinforced (sometimes called “type 3”, #3650b)
- 28-tooth double-bevel (#46372)
- 36-tooth double-bevel (#32498)
- 40-tooth (#3649)
- 140 tooth ring (1⁄4 segment, #24121)
- 2L worm (#4716)
- 28-tooth turntable (#99009/99010)
- 56 tooth turntable (sometimes referred to as “type 2”, #48168/48452)
- Standard 4L rack gear (#3743)
- Standard 8L and 14L rack gears with rounded ends and end holes (#6630 and 32185)

- 16 tooth free-spinning gear with clutch, one with splines, one without, and one with the clutch on both sides (#6542, 6542b, 18946)
- 20 tooth free-spinning gear with clutch on both sides (#81346)
- 20-tooth double-bevel free-spinning gear with clutch on both sides (#35185)

Wheels and tires:

- Technic classic split wheel hub (#3482)
- A few sizes of tires to fit it: 24x8, 30x10.5, and 43x17 mm (#3483, 2346, 3634)
- A tire for the Technic wedge belt wheel pulley (#2815)
- Technic medium racing wheel and tire (#44771/44772)
- Technic large six-spoke wheel and tire (#2998/2997)
- The hub, steering arm, and grooved ball that go with the six-spoke wheel/tire (#6540b, 2999, 2907)

Also included is a little T-shaped “support popper” tool (two pieces, glue together, in the “beam generator” file), to help in removing the disc-shaped supports used by liftarms/beams and some of the gears, if you're using those supports.

Variations

It's possible to combine two or more bricks or beams into one to create more complex shapes via boolean operations or by simply overlaying parts and exporting as one STL. You can create angled Technic liftarms, rectangular beam frames, L-shaped bricks (like the 2x2 that's missing one corner), and all manner of other “weird” shapes this way. A few of the included beams were made this way.

It is also possible to combine a generated brick/plate/beam/etc. with some other shape, such as a ball joint, a clip, hinge, etc.

It is also possible to create supersized bricks compatible with Duplo, Unico, and similar small children's toys. Simply scale the brick up by 4x and make the necessary fine adjustments to the studs, wall thickness, tubes, etc. Note that the global settings apply to all parts in a project file, so if you do something like this, you'll need to avoid mixing-and-matching normal and Duplo-sized bricks in the same file. Save the project under a new name, and use that one only for generating those supersized bricks. Otherwise, your normal-sized parts generated from this file will have tolerances suitable only for the supersized bricks.

Fair warning: Blender isn't exactly a speed demon, and trying to generate very large parts may take a long time! To reduce the wait time,

set all of your part's other options (holes' presence, axle hole, stud type, etc) first, before you crank-up the size.

As you can see from the list above, base plates can get pretty big. My computer is fairly fast, but it still took a full 31⁄2 minutes for Blender to generate the 48x48 base plate. A base plate of that size measures 384x384 mm, and there aren't many commonly-available consumer-grade 3d printers that could actually fit something that big on the bed (especially once you account for bulldog clips, corner mounts, or whatever else might obstruct the edges thereof), let alone whether the whole thing would actually stick to the bed for the full duration of the print. Still, it's included as one of the pre-rendered parts, should you find yourself in possession of a big enough printer.

Since this all takes place within a CAD program, larger parts means more visible geometry, which can stress your video card or drivers. Nothing can be done about that, but then again I have a rather old GPU by today's standards, and it handles things just fine, if a bit slow. I imagine RAM needs will balloon-out too when there's a ton of geometry, as well.

This all applies to your slicer and perhaps your printer host program, too. For those who usually print by streaming gcode from PC to printer over USB or a network, it would probably be a good idea to print especially-large parts directly from an SD card plugged into the printer. That way you can just re-print the same g-code as many times as needed, without having to re-send it, and without risking losing it if the PC crashes/reboots (that assumes you'd normally do as I do and drop the g-code in a temporary/RAM disk directory such as ‘/tmp’ after slicing).

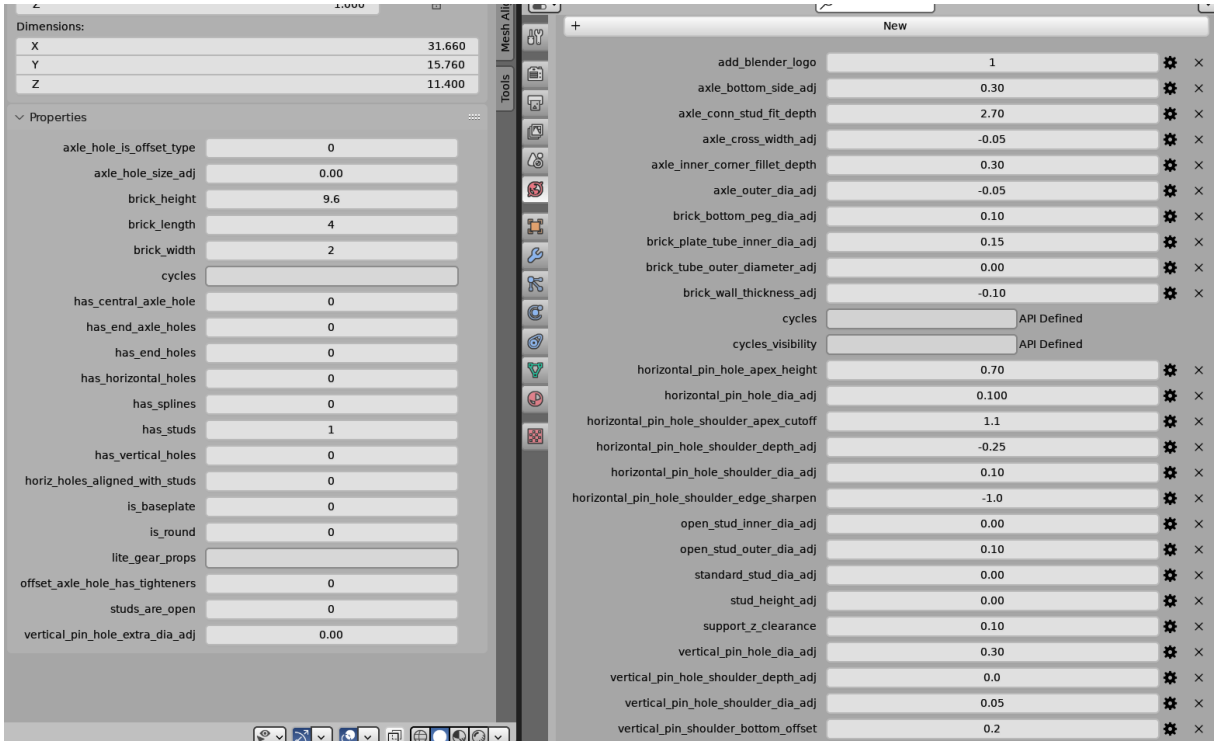
Settings and Options

In pretty much every case where I could find legit numbers, each feature of a brick, beam, etc. starts out at the official dimensions of the commercial product. For example, a stud is ideally 4.8 mm diameter and 1.6 mm tall, a brick's wall is 1.6 mm thick, the bottom pegs on N x 1 bricks are 3.2 mm diameter, and so on.

Of course, a real print will never have the exact same dimensions as specified in the models. For most 3d printing, a designer would just model his/her part to allow for some tolerance, but these building blocks have to be rather precise to fit together properly, so a bunch of adjustments are needed. That is how this project was born.

All of the various settings are described below. In the image below, you can see the “N” Sidebar on the left, showing the per-part options for a standard 4x2 brick, and on the right is the “World Properties” tab of the

main Properties pane, showing all of the project's global settings (you'll find them down at the bottom, under “Custom Properties”).



- **add_blender_logo**: When set to 1, all bricks with solid studs will get the Blender logo on the tops of the studs (commercial brands sometimes put their name or logo there).
- **axle_bottom_side_adj**: Axles have to be printed on top of supports (they have their own in this project), and like any object that uses supports, there'll be a certain amount of height inaccuracy. Adjust this parameter to account for that (higher numbers move the bottom side up).
- **axle_conn_stud_fit_depth**: Some parts such as full-size bushings or axle joiners can be pushed into the space between a group of four studs. This adjustment controls how tight that connection is.
- **axle_cross_width_adj**: If you look at the cross-section of an axle, you'll see that it's “+” shaped. This adjusts the thickness of the four "points” that make up that shape. The aforementioned axle_bottom_side_adj is subtracted from this for the bottom side.
- **axle_inner_corner_fillet_depth**: At the center where the four points meet to make the “+” shape of an axle, there's a fillet/round bevel. This adjusts its depth.
- **axle_outer_dia_adj**: The “ends” of the four points are actually rounded, as though the axle had been turned on a lathe after the main “+” shape is created. This adjusts the diameter of the “lathe” cut.
- **brick_bottom_peg_dia_adj**: On most N x 1 bricks, plates, tiles, etc., there are pegs which will wind up sitting between the studs of a brick

that's pressed into the bottom, and which also fit the “open” studs found on some Technic parts. This adjusts their diameter.
- **brick_plate_tube_inner_dia_adj**: On most N x 2 or larger bricks, plates, etc., the aforementioned pegs are replaced with larger, offset tubes that fit between sets of 4 studs, and which can themselves fit over a stud. This adjusts their inner diameter.
- **brick_plate_tube_outer_dia_adj**: This adjusts the outer diameter of those tubes.
- **brick_wall_thickness_adj**: This does just what it says on the tin. Larger numbers make the walls thicker, and always inward (the outer dimensions of a brick are not adjustable).
- **horizontal_pin_hole_apex_height**: Because holes have to be rather precise, we can't allow bridging droop at the top of a horizontal hole to affect its diameter, so this project uses a variation on the old “teardrop holes” method that used to be popular in the early days of hobbyist 3d printing. This adjustment controls the height of the teardrop's point or apex. The tip of the apex gets rounded-off more and more as it gets shorter; a setting of 0 makes a perfectly circular hole.
- **horizontal_pin_hole_dia_adj**: This adjusts the diameter of a horizontal hole (the apex is then added on top of this).
- **horizontal_pin_hole_shoulder_apex_cutoff**: All horizontal holes have a shallow “shoulder” or “inset” at each end, and like the hole itself, they use a variation on the “teardrop” shape. Since the shoulder diameter is allowed to be less precise than the hole, these models just sharply cut off the tip of the apex (to form a flat zone for bridging). This adjusts the height of that cut. If there's enough call for it, I'll rework the shoulders to use the same method used by the holes (to allow for them to be perfectly round, which would look good for resin and SLS printers).
- **horizontal_pin_hole_shoulder_depth_adj**: This adjusts the depth of those shoulders (in the axial direction).
- **horizontal_pin_hole_shoulder_dia_adj**: This also does just what it sounds like, this adjusts the diameter of the shoulders (the “teardrop” is added to this).
- **horizontal_pin_hole_shoulder_edge_sharpen**: FDM printing has a tendency to round-off outside corners due to the behavior of the plastic, even if the model is sharp, but parts with horizontal holes need a sharp corner where the hole meets the shoulder so that the various pins are retained properly. In these models, the shoulder is actually cut in a sort of “Z” shaped cross-section (imagine that the top stroke of the “Z" is the shoulder's side wall, the diagonal stroke is the shoulder's base surface surrounding the hole, and the bottom is the beginning of the hole's wall), to encourage the printer to make a sharper corner. This setting controls how “wide” the “Z” is, that is,

how sharp the angles are on those corners. A setting of 0 means no sharpening, and makes the corners a normal 90° profile.
- **open_stud_inner_dia_adj**: For parts with “open” type studs, i.e. where the stud is not a cylinder but a ring (as on some Technic parts), this adjusts the inner diameter of that ring. Ideally it should fit the peg on the bottom of an N x 1 plate/brick.
- **open_stud_outer_dia_adj,**
- **standard_stud_dia_adj**: These two are just what they sound like. One adjusts the outer diameter for open studs, one does so on solid studs. The reason there are separate settings for the two types is that plastic has a tendency to pull itself inward when making an open stud, just like what happens with a vertical hole in most prints, but that doesn't happen nearly as much with solid studs, so they need less compensation.
- **stud_height_adj**: Just what it sounds like.
- **support_z_clearance**: This adjusts the distance between a support object's top/interface surfaces and the part being supported. In most parts with supports, this is the exact distance, but in a few places where it seemed needed (such as on the turntable bottom, or the transmission driving ring), an extra 0.1 mm is added to this setting.
- **vertical_pin_hole_dia_adj,**
- **vertical_pin_hole_shoulder_depth_adj,**
- **vertical_pin_hole_shoulder_dia_adj**: These three are the counterparts to the similarly-named horizontal settings.
- **vertical_pin_shoulder_bottom_offset**: Like an axle's bottom side, the shoulder on the bottom end of a vertical hole needs to be supported, which means the real distance between shoulders will likely be a few tenths of a millimeter longer than the model, shifted downward. This lets you shift the bottom shoulder up a bit to compensate for that.

Per-brick options

- **brick_height,**
- **brick_length,**
- **brick_width**: These three are just what they sound like. Length is the size along the part's X axis, width runs along the Y axis. These sizes are measured in studs, where 1 stud is 8x8 mm (the final brick will then be trimmed 0.2 x 0.2 mm smaller). Height is measured in millimeters. A plate is 3.2 mm thick, a brick is 9.6 mm.
- **has_end_holes**: In some N x 1 plates, the stud at each end is replaced with a vertical pin hole. Set this to 1 to make this happen. The plate must be 1 stud wide, and the ends must be round.
- **has_end_axle_holes**: rather than pin holes, you can put axle holes in the ends of an N x 1 brick/plate/beam if you want.

- **has_horizontal_holes**: This adds horizontal holes to a brick, but only if it's a full 9.6 mm brick or taller, and only if it's 1 stud wide.
- **has_splines**: For N x 1 plates that have round ends with vertical end holes, setting this to 1 cuts splines into the bottom around the holes, like the ones you find on a 1⁄2-size axle bushing.
- **has_vertical_holes**: On N x 2 plates, this drills pin holes between sets of 4 studs, turning a standard plate into a Technic plate. I've only ever seen 4x2, 6x2, and 8x2 plates with these holes, but it works for anything 2x2 or larger (works in both dimensions).
- **horiz_holes_aligned_with_studs**: Normally, horizontal holes are offset by 4 mm, putting each mid-way between the two studs above it. Set this to 1 to eliminate that offset, putting them directly under the studs.
- **is_round**: Set this to 1 to make the brick/plate/tile round.
- **studs_are_open**: Set this to 1 to make the studs open instead of solid.
- **vertical_pin_hole_extra_dia_adj**: On occasion, a brick or plate with vertical holes may end up with the holes printed slightly too small or too big for some reason, even if the global vertical pin hole setting is otherwise correct for your printer and everything else is well-calibrated. This value allows you to adjust the hole size for just this one brick, and is added on top of the global adjustment.
- **is_baseplate**: set this to 1 to cut the bottom part of a brick/plate flat/featureless (1.6 mm thick), turning it into a standard base plate. If studs are turned off, they'll be added anyway.

Per-beam/liftarm options

- **beam_length,**
- **beam_thickness**: these do just what they sound like. Length is in hole count (or in studs if you like, same as any other brick). Thickness is in millimeters and can be 3.9 or 7.8.
- **has_end_axle_holes**: Just what it sounds like, set this to 1 to replace the ends' pin holes with tight axle holes.
- **has_alternating_holes**: normally, a beam has its holes running only vertically, that is, through the two flat sides, but in some cases, it's useful to turn every other hole horizontal. Set this to 1 to do that. This is also used in the process of making rectangular beam frames.
- **middle_holes_are_horizontal**: some sizes of the aforementioned beam frames need one pair of its opposing beams/sides to have all of their middle holes oriented horizontally, instead of every other one, leaving just its end holes pointing vertical (which then become the corner holes in the frame). Set this to 1 to do that.
- **horiz_inner_shoulder_uses_edge_cut**: if some of a beam's holes are turned horizontal, you can set this to 1 to have their shoulders cut all the way to the neighboring top side/edge, on one side of the hole,

leaving the other side with the usual rounded cut. This is useful when building rectangular beam frames, as only the inner-facing shoulders on one pair of sides are cut like this.

Per-part axle hole options

- **has_central_axle_hole**: Some standard bricks or plates have a vertical axle hole in the center. Set this to 1 to add one. If the brick/plate is 1 stud wide, it must be longer than 4 studs, and the length must be odd. The center stud will be deleted to make room for the hole.
- **axle_hole_size_adj**: This adjusts the tightness of an axle hole, if present. Larger values are looser.
- **axle_hole_is_offset_type**: In some bricks and other parts, an axle hole isn't “+” shaped, but rather they are roughly “bowtie” shaped. Set this to 1 to choose this shape.
- **offset_axle_hole_has_tighteners**: Some parts that use the offset-type axle have little “fingers” added back into the hole, tightening its grip. Set this to 1 to add them.

Per-axle options

- **axle_length**: This sets the length of an axle, measured in studs.
- **is_notched**: Set this to 1 to add a notch at each end of the axle

Other per-item options

- All gears with vertical pin holes respond to the global vertical pin hole adjustment.
- All gears have **axle_hole_size_adj, axle_hole_is_offset_type,** and **offset_axle_hole_has_tighteners** options, which do the same things as the settings on bricks/plates. Although you can change these settings if you want, only the size adjustment is actually useful, as the others are more or less dictated by each gear model (some gears are supposed to have offset, tightened axle holes, others are supposed to be square-only, etc).
- All axle joiners and bushings have the axle hole size adjustment also.
- The 1⁄2-size bushing has a splines option, similar to the one for round-ended plates.
- On the rack gears, you can set a custom length (in studs, as usual), and whether the rack has those rounded ends with pin/peg holes. There's a thickness setting also, which raises the teeth by 1.4 mm, for future use to build those oddball racks with pin/axle two-way connectors on the ends.

Special cases

There are a number of “special” cases here and there in order to fit-in some of the little nuances that certain commercial bricks have. Some of these include:

- If you make a brick/plate round, the corners will be filleted according to the brick's dimensions, so if the brick is square (any size), it becomes a cylinder/circle. A long, narrow brick becomes round just on its ends.
- Round bricks will get cross-braces on the bottom to keep walls from bowing-out or possibly breaking (this only looks right on bricks/plates with even length).
- Normal commercial tiles have a square shoulder on the bottom, but since that wouldn't be printable, tiles in this project will be beveled on bottom instead.
- A 1x1 brick or plate that's set to round will have a shoulder cut into the bottom so that it can be pressed down between a set of 4 studs. If it has an open stud, the stud will be drilled clean through.
- Those round 1x1 bricks/plates will use the tube inner diameter bore, ignoring the brick wall thickness setting.
- If you give a 1x1 brick a horizontal hole, it will automatically be aligned to the stud, since cutting one side of the brick would be kind of useless.
- You can mix-and-match options in weird and and creative ways to generate bricks/plates/tiles/beams that simply do not exist in the Bricklink catalog.

Changelog:

2021-02-04: In the main brick generator, in the mini brick generator in the wheels file, and in all of the relevant parts in the special bricks file, moved the open stud center cuts down by 0.2 mm. This way open studs will cut into the brick top surface by one or two layers, ensuring that they are not laid down on a totally flat surface (because doing so makes them weaker). This is done only on parts where the studs face up when printed; front-facing studs (on brackets, for example) are unchanged since they obviously wouldn't be affected by this. Re-rendered all of the affected plates and hinges.

2023-01-21/3: Fixed the diameter of the ball on the friction pin with tow ball, added fine adjustments for the axle tightness and its fillet depth for the no-friction pin with axle, and added a handful of new parts:

- axle "pin" with tow ball (#2736)
- 2L and 3L axle-to-pin perpendicular connectors (#6536, 42003)

- pin/steering link generator with example 6L link (#2739b)

2023-01-21/2: Made a minor adjustment to the sidewall of the six-spoke wheel's tire, just to tighten its grip on the rim.

2023-01-21: Added the six-spoke wheel and tire found in set #8880, and the hub, steering arm, and ball with grooves that form the primary mount/steering mechanism for them. Equivalent to LEGO #2998, 2997, 6540b, 2999, and 2907.

2023-01-19: That new wheel rim was a little bit “off” around the hub, didn't fit right on the three-pin axle mount from set #8070. Fixed.

2023-01-18: Added Technic medium racing wheel and tire (#44771/44772)

2023-01-14: Added several models:

- the classic Technic wheel hub (#3482)
- a few tires to fit it (#3483, 2346, 3634)
- a tire for the wedge belt wheel pulley (#2815 to fit #4185)
- several sizes of belts (for pulleys).

2023-01-12: Increased the horizontal space between brackets and their front supports, and raised the bottoms of the “rungs” of the “ladder” to help keep bridging droop off of the front studs. Also fixed a glitch where front studs got broken if not set to open (the Blender logo was ignoring that extra stud height adjustment I added yesterday). Re-rendered all of the bracket STLs... for the umpteenth time.

2023-01-11/3: Added the newer version of the 24 tooth gear with the single axle hole, and the newer version of the 16 tooth gear with the reinforced center hub, and added the recent 20 tooth gear. Also tweaked the 24 tooth 3-hole gear's supports to make them easier to remove.

2023-01-11/2: Increased default open stud outer diameter adjustment to +0.3 mm in all project files, and re-rendered a number of parts:

- Technic classic beams (all 3)
- The 5x1 and 8x1 round-ended plates, with and without splines
- The 2x1 brick hinge top section
- The 5x1 2-part hinge plate
- The jumper plates (all 4)
- The brackets (all 11 of them... again.)

Also, I gave the brackets an extra setting tweak for the front-side stud “height” so that they can be made longer than top-side studs, in case they come out too short when printed. The default is +0.1 mm.

2023-01-11: Fixed a minor screwup in the 20 tooth (single-) bevel gear's supports... twice 😛... also, increased the supports' Z clearance by 0.1 mm.

2023-01-10/2: Made the brackets' front sides 0.1 mm thinner (moved the inside surface) just to ensure they will sit square on other bricks, re-rendered all bracket STL's.

2023-01-10: Fixed a subtle bug in the bracket generator that was causing a round cut to be added to the bottom side of the top section when the top is 1x1, which was reducing the bottom-side's grip. Re-rendered/uploaded the affected STLs as well.

2023-01-09/2: Minor tweak to the support Y distance on those brackets - the bottom of the “ladder” for the side studs was too close. Re-rendered and re-uploaded the entire lot, just to be sure.

2023-01-09: Added a handful of standard brackets in various configurations (see list above)

2023-01-08: Added 28-tooth turntable (#99009/99010)

2023-01-07: Added a handful of new models:

- Old-fashioned vehicle roof hinge (the one that flips up and measures 4x5 studs when combined, like LEGO #4213/4315)
- Old fashioned 5x1 hinge plates (comparable to LEGO #4275/4276, but I had to make the joining fingers 2+1 rather than 3+2, for strength)
- Technic pins, with and without friction, in a variety of styles -- short, long, half-size with studs, with axle, with tow ball, with endstop... These pins print vertically for quality-sake, so make sure you use good quality filament, print hot, and use as little fan as you can get away with, to avoid layer bonding issues
- I also moved the support popper tool to the “beam generator” workfile since that's what it was originally intended for.

2023-01-06/2: Added two new hinge types - one of those 4x1/2x2 “swivel” bricks, and the equivalent plate (comparable to LEGO #3830/3831 and 2429/2430). These are “print-in-place” designs, i.e. the two parts of each swivel are printed together and come off the plate already joined. You may have to “break” them loose after printing, but that should be barely a thing. The tightness of the swivels is adjustable.

2023-01-06: Somehow, the default stud diameter adjustment got reset to 0, but it's supposed to be 0.3. Or at least, that's the setting that works well for my machine. Changed it in all files, and re-rendered the various “modified” bricks and plates that bear those 3mm-compatible clips, since

those are the only things that got the incorrect setting among all of my printed parts.

2023-01-05/3: Made the hinge pivot tightness adjustable and simplified the two pieces' modifier and driver stacks (just trimming-out stuff this brick can't use or doesn't need). Also made the tops of the supports respond to the global support offset setting, and reworked them a bit to improve their alignment and to make sure they have as much contact with the plate as possible (within reason), just so they can't fall off/down.

2023-01-05/2: Reworked that hinged brick a bit to improve printability, appearance, and strength. The result is much better.

2023-01-05: Added a 2x1 hinged brick (this is that classic one that's basically a 2x1 brick with horizontal pivot, where the top “folds” down to one side – equivalent to LEGO #3937/3938)

2023-01-04/3: Added Technic rack gears, with configurable length.

2023-01-04/2: Added 2x2 and 4x4 corner bricks, and added that well-known 2x1 tile with grille cut pattern.

2023-01-04: Added several kinds of plates and bricks featuring those little round clips that are meant to grab onto a 3mm peg/post.

2023-01-03/4: Fix the fix 😛 Somehow that last re-alignment got lost in the “special bricks” workfile just before saving/exporting. Oh well, it's fixed for sure now.

2023-01-03/3: Discovered and fixed a subtle alignment error in the brick generator and in the panels and jumper plates I recently uploaded (the cause was the fix I made to that shape error yesterday, forgot to double-check things afterward). Its slight enough not to negatively impact printed parts (only 0.1-0.12 mm, depending on the feature), but it needed fixed nonetheless.

2023-01-03/2: Added panels in several sizes

2023-01-03: Added four types of “jumper” plates in 4x2, 2x2, 3x1, and 2x1 sizes.

2023-01-02: Added another small pulley (equivalent to LEGO #2983).

2023-01-01/2: Fixed a minor error in the shape of the 5x3 long-gusset triangle (forgot some cuts on the underside).

2023-01-01: Fixed a minor size bug in the brick generator. It's little more than cosmetic in an actual print, but it needed fixed anyway, as it also fixed a rendering bug with large base plates, though how the two are

related escapes me. 😀 Since that part works now, I've added 32x32 and 48x48 base plates as well.

2022-12-31/3: Added two 5x3 triangle half-thick liftarms (comparable to LEGO parts #2905 and #99773)

2022-12-31/2: Made it possible for beams with some of its holes turned horizontal, to have normal round shoulders on both sides as on any other object bearing them (rather than one side always having the shoulder cut through to its neighboring top edge – that's optional now), as there are some official beams that are like this. Added an example of one such beam (11L, equivalent to LEGO part #73507).

2022-12-31: Split the Blender project into separate files (brick generator, beam generator, the gears, and the other miscellaneous Technic parts), for the sake of performance and to simplify things a little more.

2022-12-30/2: Slightly reworked the three gears with clutches on both sides, just to improve printed accuracy – their bottom insides were too low (forgot to take bridging droop into account), and they had some excess beveling.

2022-12-30: Added the large Technic “steering” pulley and small Technic “wedge belt wheel” pulley.

2022-12-29/2: Added a few gears:

- 16-tooth free-spinning clutch gear with the clutch on both sides
- 20 tooth plain spur and double-bevel free-spin gears with clutch on both sides

2022-12-29: Made some performance improvements:

- The project was getting too slow with each re-calculation, so I've streamlined it – which meant deleting most of the bricks, plates, etc. from the project file. Of course you can still create almost any brick shape you want, and all of the pre-rendered STLs are still present, this is just to slim-down the Blender project file itself, which helps speed up the program, and there's no point in keeping them when you can just create them anew if you want to.
- Split-off the modern beams/liftarms from the regular bricks, and simplified them a little (lots of stuff that applies to bricks or plates doesn't apply to beams). They're still in the same file, but now they have a lot less geometry to deal with.
- Made it possible to turn some of a beam's hole horizontal
- Added rectangular liftarm/beam frames in 5x7, 7x11, and 11x15 sizes

2022-12-25: several upgrades:

- You can now make proper base plates by creating a brick or plate of the desired size and then setting the appropriate flag. Studs will be added if missing, and the bottom will be cut flat, 1.6 mm thick. An example measuring 16x16 studs is provided.
- You can now make half-thickness beams/liftarms, by setting the brick height to 3.9 mm (along with the other settings needed to create them).
- N x 1 bricks, plates, and Technic beams/liftarms can now have axle holes at each end, in place of any pin holes or studs that may be present.
- Added a couple of half-thickness beams (5L normal, and 5L with end axle holes)
- Added the “modified stud connector” (like LEGO #2825, a 4L half-thickness beam with one fat end, and axle holes in the ends).
- Added a couple of examples of angled liftarms - 6/4 (53.13°) with end axle holes and 5/3 (90°). These are formed by simply overlaying one beam on top of another, with one of them appropriately rotated, and exporting the two as a single STL file (SuperSlicer seems happy with this arrangement and it's simpler and more reliable than trying to boolean them together in Blender)
- Added 4x1 and 2x1 bricks, plates, and tiles.
- Added 8x2 and 6x2 Technic plates.
- Added 8L and 6L studded beams

Model files

Bricks-plates-tiles	81 files
standard-brick-4x2.stl	
standard-brick-4x1.stl	
standard-brick-2x1.stl	
standard-plate-4x2.stl	

standard-plate-4x1.stl

standard-plate-2x1.stl

standard-tile-4x2.stl

standard-tile-4x1.stl

standard-tile-2x1.stl

standard-tile-2x1-grille.stl

standard-panel-4x1.stl

standard-panel-3x1.stl

standard-panel-2x1.stl

standard-panel-2x1-three-sided.stl

standard-panel-2x1-with-center-divide.stl

standard-panel-2x2-corner.stl

standard-panel-1x1-corner.stl

standard-brick-4x4-corner.stl

standard-brick-2x2-corner.stl

standard-ish-brick-4x4-round.stl

standard-ish-plate-4x4-round.stl

standard-brick-2x2-round.stl

standard-plate-2x2-round.stl

standard-brick-1x1-round.stl

standard-brick-1x1-round-with-open-stud.stl

standard-plate-1x1-round.stl

standard-plate-1x1-round-with-open-stud.stl

standard-tile-1x1-round.stl

standard-baseplate-16x16.stl

standard-baseplate-32x32.stl

standard-baseplate-48x48.stl

standard-2x1-brick-hinge-bottom.stl

standard-4x1-two-part-hinged-plate-print-in-place.stl

standard-4x1-two-part-hinged-brick-print-in-place.stl

vehicle-hinged-roof-plate.stl

vehicle-hinged-roof-plate-with-supports.stl

standard-5x1-two-part-hinged-plate-horizontal-pivot.stl

standard-2x1-brick-hinge-top.stl

standard-2x1-brick-hinge-top-with-supports.stl

modified-plate-1x1-with-vertical-grip-clip.stl

modified-plate-1x1-with-horizontal-grip-clip.stl

modified-plate-1x1-with-horizontal-grip-clip-with-s… .stl

modified-plate-2x1-with-vertical-grip-clip-on-end.stl

modified-plate-2x1-with-horizontal-grip-clip-on-end.stl

modified-plate-2x1-with-horizontal-grip-clip-on-end… .stl

modified-plate-2x1-with-two-horizontal-grip-clips.stl

modified-plate-2x1-with-two-horizontal-grip-clips-w… .stl

modified-brick-1x1-with-vertical-grip-clip.stl

modified-brick-1x1-with-vertical-grip-clip-with-sup… .stl

modified-brick-1x1-with-horizontal-grip-clip.stl

modified-brick-1x1-with-horizontal-grip-clip-with-s… .stl

modified-brick-2x1-with-vertical-grip-clip.stl

modified-brick-2x1-with-vertical-grip-clip-with-sup… .stl

modified-brick-1x1x3-with-two-vertical-grip-clips.stl

modified-brick-1x1x3-with-two-vertical-grip-clips-w… .stl

standard-jumper-plate-2x1-1-stud.stl

standard-jumper-plate-3x1-2-studs.stl

standard-jumper-plate-2x2-1-stud.stl

standard-jumper-plate-4x2-2-studs.stl

standard-bracket-1x1-1x1.stl

standard-bracket-1x1-1x1-with-supports.stl

standard-bracket-1x1-1x1-inverted.stl

standard-bracket-1x1-1x1-inverted-with-supports.stl

standard-bracket-1x1-1x2-vertical.stl

standard-bracket-1x1-1x2-vertical-with-supports.stl

standard-bracket-1x1-1x2-vertical-inverted.stl

standard-bracket-1x1-1x2-vertical-inverted-with-sup… .stl

standard-bracket-2x1-2x1.stl

standard-bracket-2x1-2x1-with-supports.stl

standard-bracket-2x1-2x1-inverted.stl

standard-bracket-2x1-2x1-inverted-with-supports.stl

standard-bracket-2x1-2x2.stl

standard-bracket-2x1-2x2-with-supports.stl

standard-bracket-2x1-2x2-inverted.stl

standard-bracket-2x1-2x2-inverted-with-supports.stl

standard-bracket-2x1-4x1.stl

standard-bracket-2x1-4x1-with-supports.stl

standard-bracket-2x1-4x2.stl

standard-bracket-2x1-4x2-with-supports.stl

standard-bracket-6x2-6x1-inverted.stl

standard-bracket-6x2-6x1-inverted-with-supports.stl



Liftarms-beams 24 files

technic-beam-modern-5l.stl

technic-beam-modern-5l-with-supports.stl

technic-beam-modern-11l-with-alternating-holes.stl

technic-beam-modern-11l-with-alternating-holes-with… .stl

technic-beam-modern-5l-half-thickness.stl

technic-beam-modern-5l-half-thickness-with-supports.stl

technic-beam-modern-5l-half-thickness-with-end-axle… .stl

technic-beam-modern-5l-half-thickness-with-end-axle… .stl

technic-beam-modern-4l-modified-stud-connector-with… .stl

technic-beam-modern-4l-modified-stud-connector.stl

technic-liftarm-5-3-with-90-degree-bend.stl

technic-liftarm-5-3-with-90-degree-bend-with-suppor... .stl

technic-liftarm-6-4-with-5313-degree-bend-with-supp... .stl

technic-liftarm-6-4-with-5313-degree-bend.stl

technic-liftarm-beam-frame-5x7.stl

technic-liftarm-beam-frame-5x7-with-supports.stl

technic-liftarm-beam-frame-7x11.stl

technic-liftarm-beam-frame-7x11-with-supports.stl

technic-liftarm-beam-frame-11x15.stl

technic-liftarm-beam-frame-11x15-with-supports.stl

technic-liftarm-5x3-triangle-short-gussets.stl

technic-liftarm-5x3-triangle-short-gussets-with-sup... .stl

technic-liftarm-5x3-triangle-long-gussets.stl

technic-liftarm-5x3-triangle-long-gussets-with-supp... .stl



Gears-gear-like 52 files

technic-gear-8-tooth.stl

technic-gear-8-tooth-with-supports.stl

technic-gear-12-tooth-bevel.stl

technic-gear-12-tooth-bevel-with-supports.stl

technic-gear-12-tooth-double-bevel.stl

technic-gear-14-tooth-bevel.stl

technic-gear-14-tooth-bevel-with-supports.stl

technic-gear-16-tooth.stl

technic-gear-16-tooth-with-supports.stl

technic-gear-16-tooth-v2-reinforced.stl

technic-gear-16-tooth-v2-reinforced-with-supports.stl

technic-gear-20-tooth-with-supports.stl

technic-gear-20-tooth-bevel.stl

technic-gear-20-tooth.stl

technic-gear-20-tooth-bevel-with-supports.stl

technic-gear-20-tooth-double-bevel.stl

technic-gear-24-tooth-one-axle-hole.stl

technic-gear-24-tooth-one-axle-hole-with-supports.stl

technic-gear-24-tooth-three-axle-holes.stl

technic-gear-24-tooth-three-axle-holes-with-supports .stl

technic-gear-24-tooth-crown-type-3.stl

technic-gear-24-tooth-crown-type-3-with-supports.stl

technic-gear-28-tooth-double-bevel.stl

technic-gear-28-tooth-double-bevel-with-supports.stl

technic-gear-36-tooth-double-bevel.stl

technic-gear-36-tooth-double-bevel-with-supports.stl

technic-gear-40-tooth.stl

technic-gear-40-tooth-with-supports.stl

technic-gear-140-tooth-quarter-ring.stl

technic-gear-140-tooth-quarter-ring-with-supports.stl

technic-gear-worm-2l.stl

technic-gear-16-tooth-free-spin-with-clutch.stl

technic-gear-16-tooth-free-spin-with-clutch-with-su… .stl

technic-gear-16-tooth-free-spin-with-clutch-splined.stl

technic-gear-16-tooth-free-spin-with-clutch-splined… .stl

technic-gear-16-tooth-free-spin-with-clutch-on-both… .stl

technic-gear-16-tooth-free-spin-with-clutch-on-both… .stl

technic-gear-20-tooth-free-spin-with-clutch-on-both… .stl

technic-gear-20-tooth-free-spin-with-clutch-on-both… .stl

technic-gear-20-tooth-double-bevel-free-spin-with-c… .stl

technic-turntable-28-tooth-top.stl

technic-turntable-28-tooth-top-with-supports.stl

technic-turntable-28-tooth-bottom.stl

technic-turntable-28-tooth-bottom-with-supports.stl

technic-turntable-type-2-top.stl

technic-turntable-type-2-bottom.stl

technic-turntable-type-2-bottom-with-supports.stl

technic-rack-gear-4l.stl

technic-rack-gear-8l-with-end-holes.stl

technic-rack-gear-8l-with-end-holes-with-supports.stl

technic-rack-gear-14l-with-end-holes.stl

technic-rack-gear-14l-with-end-holes-with-supports.stl



Technic-all-other 57 files

technic-beam-classic-4l.stl

technic-beam-classic-6l.stl

technic-beam-classic-8l.stl

technic-plate-5x1-round-ends-with-holes-with-center… .stl

technic-plate-5x1-splined-round-ends-with-holes-wit… .stl

technic-plate-8x1-round-ends-with-holes.stl

technic-plate-8x1-splined-round-ends-with-holes.stl

technic-plate-4x2.stl

technic-plate-6x2.stl

technic-plate-8x2.stl

technic-axle-2l-notched.stl

technic-axle-2l-notched-with-supports.stl

technic-axle-4l.stl

technic-axle-4l-with-supports.stl

technic-axle-bushing-full-size.stl

technic-axle-bushing-half-size.stl

technic-axle-bushing-half-size-splined.stl

technic-axle-bushing-half-size-splined-offset-style… .stl

technic-axle-joiner-2l-with-ridges-for-driving-ring.stl

technic-axle-joiner-2l-plain.stl

technic-transmission-driving-ring-2l.stl

technic-transmission-driving-ring-2l-with-supports.stl

technic-pulley-9v-micro-motor.stl

technic-pulley-wedge-belt-wheel.stl

technic-pulley-wedge-belt-wheel-with-supports.stl

technic-pulley-steering-large.stl

technic-pulley-steering-large-with-supports.stl

technic-pin-with-friction.stl

technic-pin-with-friction-with-supports.stl

technic-pin-without-friction.stl

technic-pin-without-friction-with-supports.stl

technic-pin-with-friction-3l.stl

technic-pin-with-friction-3l-with-supports.stl

technic-pin-without-friction-3l.stl

technic-pin-without-friction-3l-with-supports.stl

technic-pin-without-friction-3l-with-stop.stl

technic-pin-with-friction-half-with-open-stud.stl

technic-pin-with-friction-half-with-open-stud-with-... .stl

technic-pin-without-friction-half-with-open-stud.stl

technic-pin-without-friction-half-with-open-stud-wi… .stl

technic-pin-without-friction-three-quarter.stl

technic-pin-without-friction-three-quarter-with-sup… .stl

technic-pin-without-friction-with-axle.stl

technic-pin-without-friction-with-axle-with-supports .stl

technic-pin-with-friction-with-tow-ball.stl

technic-pin-with-friction-with-tow-ball-with-suppor… .stl

technic-axle-with-tow-ball.stl

technic-axle-with-tow-ball-with-supports.stl

technic-belt-16-mm.stl

technic-belt-24-mm.stl

technic-belt-32-mm.stl

technic-belt-40-mm.stl

technic-belt-56-mm.stl

technic-axle-pin-connector-perpendicular-2l.stl

technic-axle-pin-connector-perpendicular-2-pin-hole… .stl

technic-pin-link-6l.stl

technic-pin-link-6l-with-supports.stl

Wheels and tires

20 files

- technic-wheel-with-split-axle-hole.stl
- technic-wheel-with-split-axle-hole-with-supports.stl
- technic-tire-24-x-8-mm.stl
- technic-tire-30-x-105-mm.stl
-  technic-tire-43-x-17-mm.stl
- technic-wedge-belt-wheel-tire.stl
- technic-medium-racing-wheel-56-x-24-mm.stl
- technic-medium-racing-wheel-supports.stl
- technic-medium-racing-tire-for-56-x-24-rim.stl
- technic-medium-racing-tire-supports.stl
- technic-medium-racing-wheel-56-x-24-mm.3mf
- technic-six-spoke-wheel-816-x-34-mm.stl
- technic-six-spoke-wheel-supports.stl
- technic-six-spoke-wheel-816-x-34-mm.3mf
- technic-tire-816-x-34-mm-for-six-spoke-wheel.stl
- technic-tire-816-x-34-mm-for-six-spoke-wheel-suppor… .stl

technic-steering-wheel-hub-large-for-six-spoke-wheel .stl

technic-steering-arm-large-with-wheel-hub-holder-fo… .stl

technic-steering-arm-large-with-wheel-hub-holder-fo… .stl

technic-ball-with-grooves-for-six-spoke-wheel.stl

support-popper-tool.stl



beam-generator.blend



technic-gears.blend



other-technic-parts.blend



brick-generator.blend



wheels-and-tires.blend



special-bricks-plates-similar.blend

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