



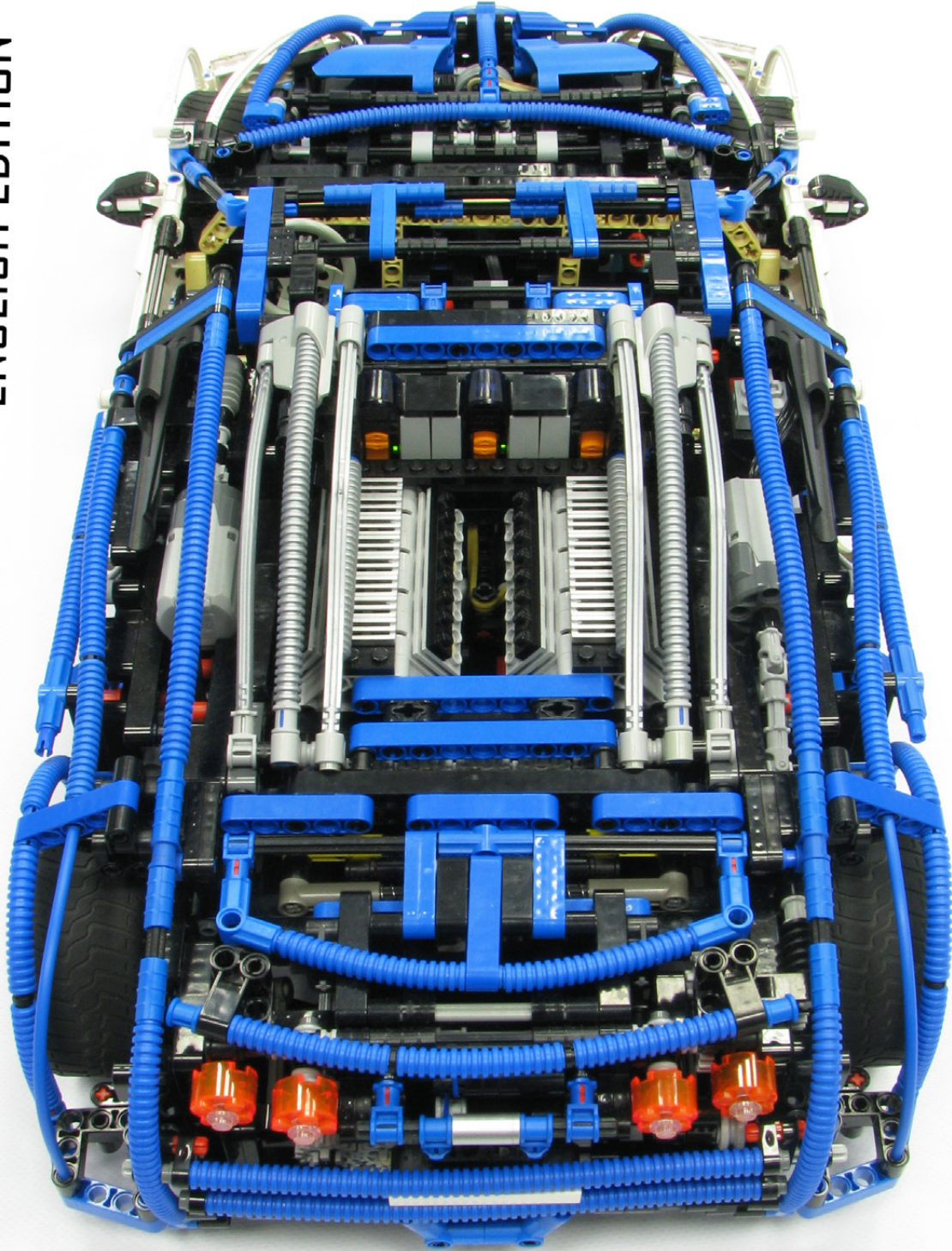
# 1007



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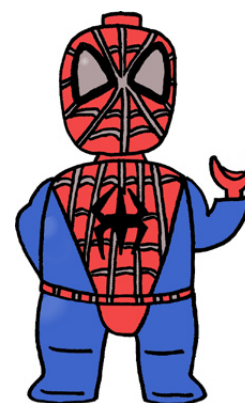


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# Editorial: 2<sup>nd</sup> Anniversary

by Lluïsgib



Just two years ago we began this project with high hopes and a certain audacity, and we confess that we did not know what we were getting into. Editing each issue of the magazine takes about 3 months of work, from the moment we begin to think about the contents, until you find the file on our website ready to download. Currently, the magazine has about 3,000 downloads. This figure has been increasing in each issue and we hope it will continue along this path.

This is my last editorial as LEGO® Ambassador. So I would like to acknowledge the selfless work of some people who, issue after issue, have spent tens of hours on this magazine so you could have a new issue to read.

The ideologue and head of the magazine is Carlos (car\_mp on the internet). It was he who called me one day and said "What do you think about making a magazine about LEGO?". I loved the idea and gave him all the support I could. Carlos is the one who spends hours looking for articles, struggling with deadlines, making the layout of the magazine and looking for new ideas to incorporate to keep you interested.

Jetro has gained prominence (and work) within the magazine. He started as a writer and has emerged as a translator and reviewer of articles in both Spanish and English. It is curious that this work is done by a Dutchman ... In addition, he remains an inexhaustible (?) source of articles about Technic® and Mindstorms®.

Jesus (Arqu medes) has delighted us in every issue with his comics, full of wit and fun. He always offers us a very peculiar and different point of view of our world.

Antonio (Legotron) is one of those writers who always has something to contribute, whether a tree or an Imperial hangar of more than 5 square meters. He is an imaginative AFOL and it shows every four months.

Finally, The LEGO Company has also been involved from the beginning. From Denmark, by Jan Beyer, offering sets for reviews, gifts for competitions and an enviable network of contacts to access the deepest recesses of the Company. From Spain, Joachim Schwidtal and Rosa Seegelken are always willing to send any kind of artwork we need and they also offer material for alternative models.

These are all the people who haven't missed a single the quarterly meeting of Hispabrick Magazine during these two years. To all of them my sincere thanks, and also to all the people who, to a greater or lesser extent, have contributed to make this dream a reality: to have a Spanish magazine, dedicated to LEGO bricks, with an international outlook.

#

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# Bugatti Veyron

*If you were missing a supercar...*

*Text and images by Sheepo*

Ever since Technic appeared back in the 70's, one of the main pillars of the line were the Supercars. So far 5 of them have been released: 853 (1977), 8860 (1980), 8865 (1988), 8880 (1994) and 8448 (1999).

With each Supercar, LEGO® showed us new mechanisms such as the independent rear suspension of the 8860, the double traction of the 8880, and the 5 speed gearbox plus reverse of the 8448. But after the fantastic Super Street Sensation, LEGO hasn't produced any Supercar... and 10 years without a new one are too many.

Like most Technic fans, I love sets with a high piece count, complex mechanics and most of all: character, something the Supercars exhibited. Longing for the Supercars, the thought of making my own by putting all the knowledge I acquired during these past 15 years into practice became stronger.

Building something different and new, while maintaining the essence of the Supercars and adding new mechanisms (if possible) was something I was set on from the beginning. Whenever I looked on the Internet, I kept finding awesome MOCs, but most of them used the same old mechanisms (with a few exceptions) and many even used the same gear box the 8448 had (some built it studless, but essentially it is the same thing).

I also wanted to base it on a real car, but I wanted one with a central motor, double traction, and it had to be exotic and exclusive.

All these requirements left just a couple of Lamborghini and the Bugatti Veyron. This last one is way more exotic, but at the same time harder to recreate due to all the curves and the limited technical information available.

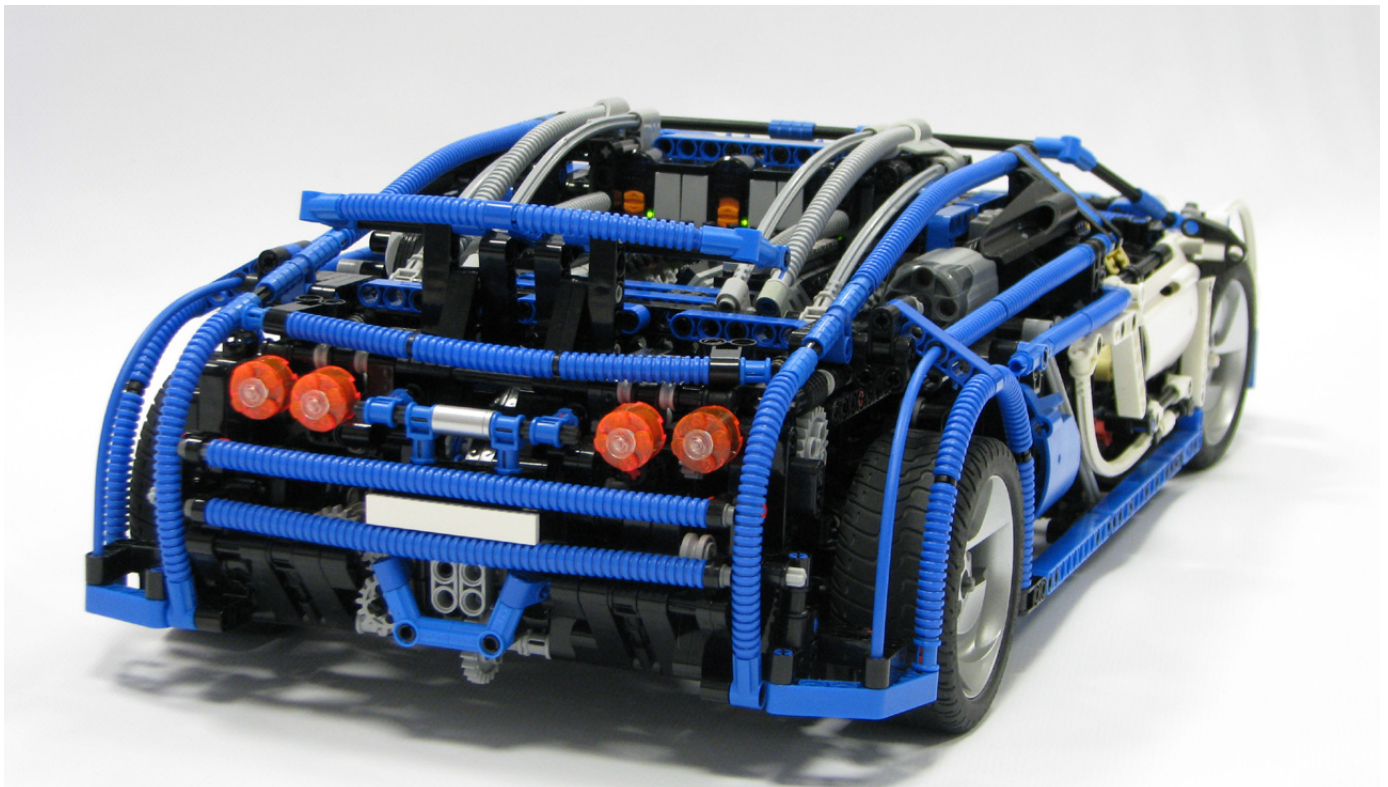
In the end I chose the Veyron for being more spectacular and exclusive, its 1001cv motor and the 407 km/h it can reach.

I decided to divide the building process into different and independent phases for a more successful result, something like on the 8448. Overall it took 6 different phases.

## **Phase 1. Gear Box**

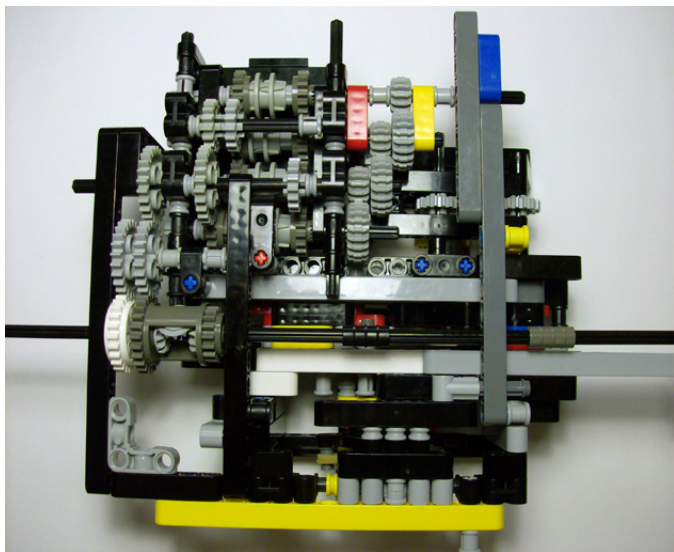
They always say that sport cars are designed from the inside out. In my case I did the very same, I built the gear box first and designed the rest to fit it properly.

I'd been thinking how to build a synchronized sequential gearbox for a long time without any success. After starting this project I understood that if I wanted to make something





innovative I needed a gearbox like that, so I made it my priority and spent all my available building time on it. After a month and a dozen prototypes I came up with a fully functional model of reasonable proportions. Even so, the gearbox is still pretty big, but personally I still think it is worth using, even if it only fits in bigger MOCs.



As I already mentioned, most builders end up using the 8448 gearbox for building MOCs because even though its functionality is a bit coarse, it is compact and reliable, making it really versatile when adding it into a MOC. For these very reasons I decided to use it as a base for building mine. Initially it was going to have only 5 gears and a reverse, like the 8448, but once the design was finished I realized that making it 4 studs bigger would allow me to add 2 extra gears (the same number as a real Veyron), and this improved the results.

The gearbox works with a system of rockers that are placed in line and operated by a selector. I think it isn't necessary to explain the mechanism in depth, but if you want to know more about it, please visit the following links:

Spanish: <http://www.hispalug.com/foro/index.php?topic=9335.0>  
English: <http://www.mocpages.com/moc.php/180863>

### Phase 2. Gearbox plus rear axle

Normally you would build the rear axle independently from the gearbox, but I did it this way so the result would act as a structural element as well as complementing the chassis through some reinforcements.

The suspension structure is built using two overlapped triangles with shock absorbers placed and activated in a pushrod position (similar to the system used in F1). I'm not sure if the real Veyron is built this way, but I placed them like that because it was handier and made it look more appealing.

I've been building mechanical systems that LEGO® has never used in their sets for years now. Among them, I built some transmission brakes with some uneven results. Trying to stick to my goal of adding new mechanisms to this car, after a few tries I managed to design a system of friction based brakes that was compact enough to fit within a tire (the tires from 8448). This way I was able to place it in each of the wheels to achieve a system closely similar to that of a real car.

The way it works is rather simple. It is just a soft tyre placed within the same axle the tyre is attached to and a piece connected to the suspension that contacts with it, producing a progressive brake (the more you press the piece, the more it brakes).

Apart from the friction based brakes, the system has another mechanism. If the part that contacts the tyre is activated in the opposite direction, it will hit the inner spokes and act like a handbrake, blocking the wheel.

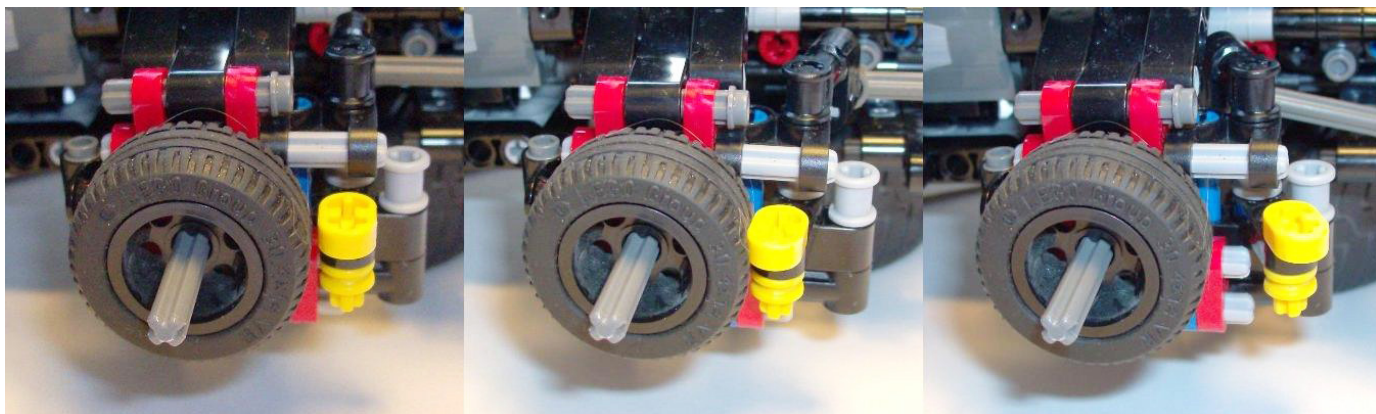
### Phase 3. Front axle

I've always thought that making axles and suspensions with LEGO parts specifically made for such uses was simply too easy. And that's why I try to avoid them whenever I can, unless there is no other option. I tend to use links, and this axle was no exception.

This axle, just like the one in the real Veyron and the aforementioned rear axle, uses a system of two overlapped triangles. In this case the shock absorbers are placed vertically to save as much space as possible, because otherwise they would be popping out of the hood.

The front axle uses the same braking system as the rear one, and while the functionality is the same, it is adapted to the steering gears. Unlike the rear axle it doesn't have a handbrake, because most cars don't have it either. For preventing the handbrake from activating in the front axle at the same time as the rear axle, I placed a small mechanism between both axles that slows down the spin of the transmission.

The steering system is placed in front of the axle, built flat and low for leaving enough space to add a trunk, which sits right on top of it.





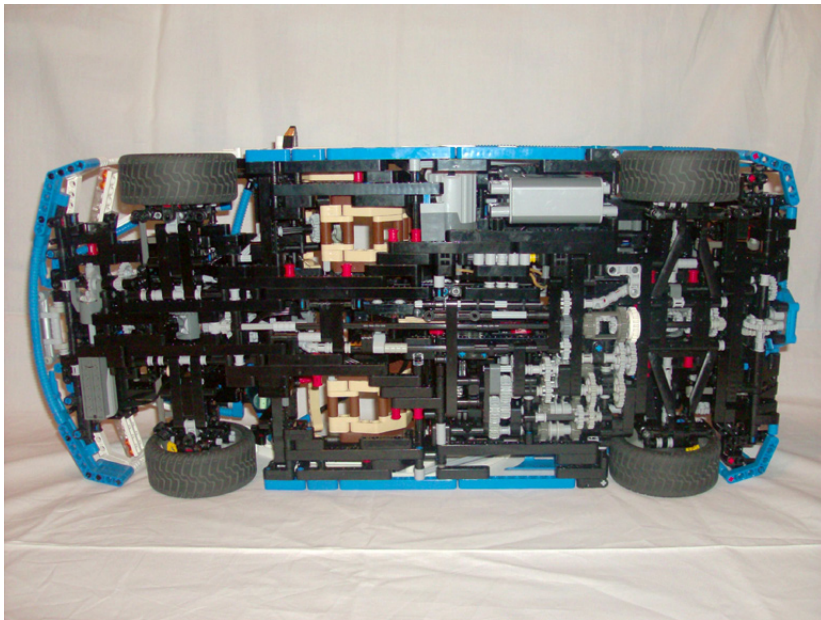
## Phase 4. Chassis

In order to have all the parts well connected, it is necessary to build a chassis that is robust enough that it doesn't get deformed, but for this car it needed to be compact as well. Not only is the car really low, but the elements that needed to be placed in it were a tad big (Phase 2 for example).

For all these reasons and for keeping it as realistic as possible, I decided to go with a unibody frame, leaving aside the typical double beam chassis LEGO® likes to use.

The result is a tangle of liftarms forming a single block that is full of openings for placing all the needed elements (Phase 2 and 3). It also has enough space for the inside of the car, the trunk, and some extra openings for adding other elements necessary for the car to function (such as the transmission, different levers and the electric system).

Included in this phase, even though it technically isn't part of the chassis, is the distribution and brake synchronizing system, placed right behind the rear axle.



## Phase 5. Motorization

When I started developing this car I wasn't planning on motorizing it. I just wanted to make a car the old way, with some lever to control different mechanisms and such, but seeing how widespread and versatile Power Functions are, I found them appropriate for this. Now all the important mechanics are motorized.

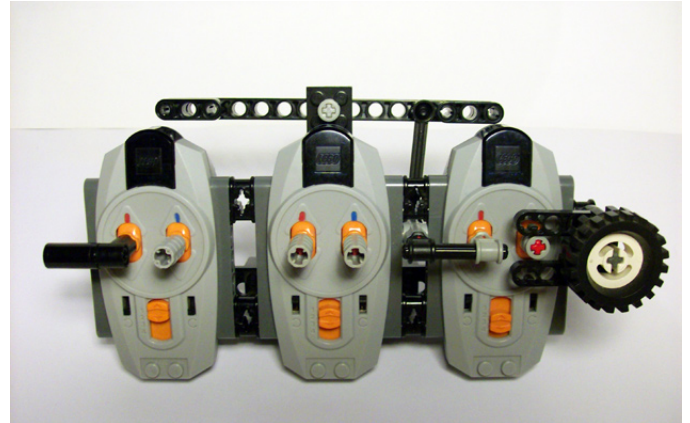
All in all, the car uses a PF Battery, three PF receivers, three PF remote controls, an RC motor, a PF XL motor, and four PF M motors.

So, in a schematic way, the functions are:

Remote Control No.1 controls:

- Red: Accelerator. RC Motor used for moving the whole car.
- Blue: Brakes. M Motor. If pushed it backwards the friction brakes are activated, but only as long as it is pushed. As soon as it is released the brakes will deactivate. On the other hand, if pushed forward the hand brake is activated, which will stay

activated even after releasing the lever. To deactivate it you just need to push it back and release it.



The use for Remote Controller No.2 will be explained in Phase 6.

Remote Controller No.3 controls:

- Red: Sequential Gear Box. XL Motor. This button is connected to a double lever in front of the set of controllers for changing gears more comfortably, just like in F1 cars. If you press it to the right it increases gears, and if you press it to the left it decreases. The gear shift lever placed inside the car will move synchronized to the gear box whenever you change gears with the remote controller.
- Blue: Steering. M Motor. Apart from moving the wheels, it will move the steering wheel as well.

## Phase 6. Bodywork

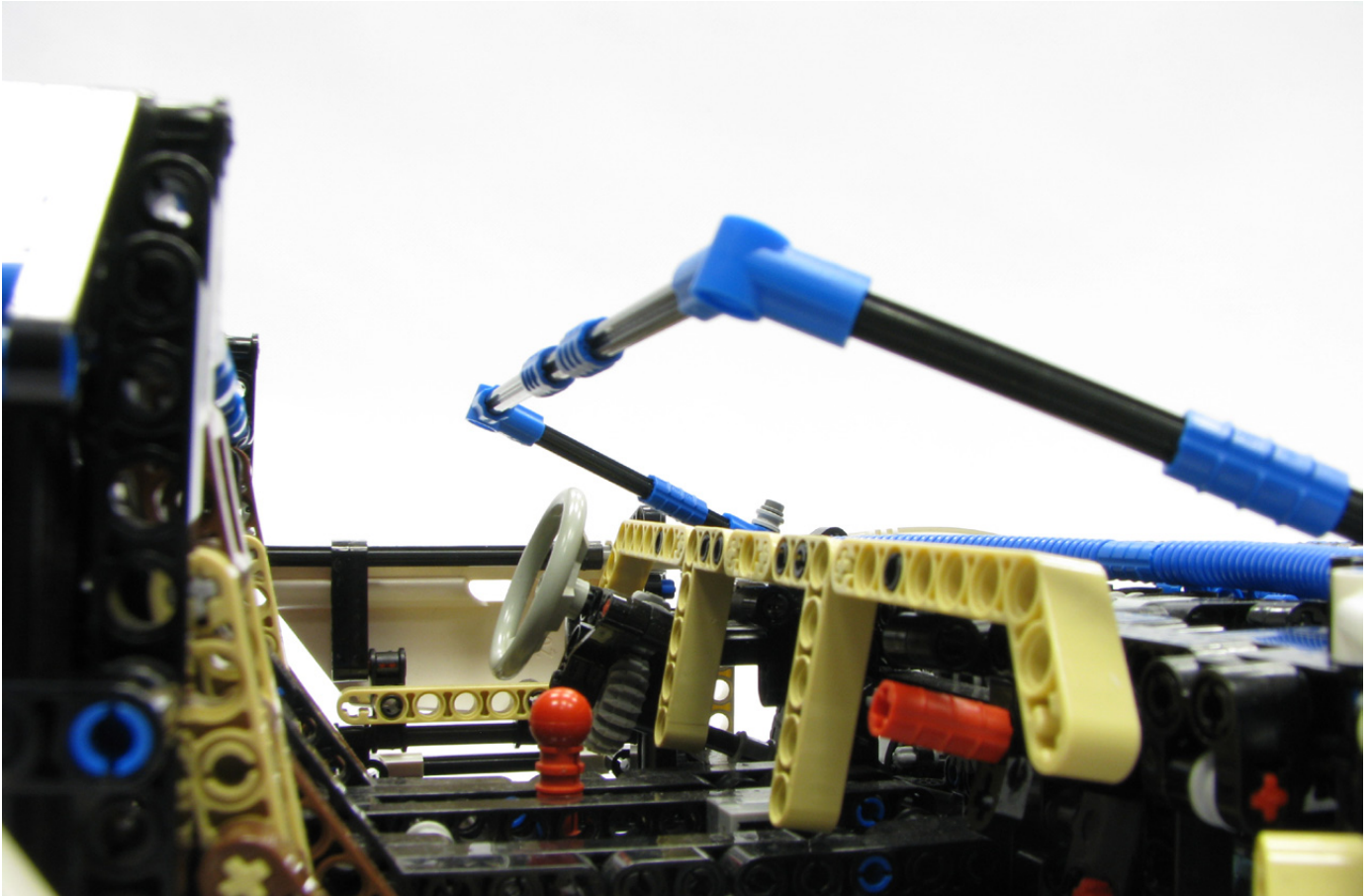
When I started developing the car, I calculated the approximate scale using the diameter of the wheels (81.6mm) as a base. According to that, the car should have been roughly around 65 studs long. But that was a tad too small, so I increased the size to 71. Due to this, the wheels are slightly smaller than they should be, but these extra 6 studs gave me a lot of space for adding more functions and mechanisms.

In order to be able to build the bodywork without having any problems with the chassis, I was cautious and left a 2 stud margin all around the car.

The final shape of the car maintains the proportions of the length, width, height, wheelbase, hood length and probably some other proportions as well. With this, the final proportion would be around 1:8, and the build comes to 71x31x18.5 studs.

The typical paint work of a Veyron features two different colours. Blue for the base, and an additional colour for the hood, fins and doors, so I did the same and went with the colours I liked most: blue and white.

The bodywork features elements such as opening doors. They open normally, but in order to prevent them from doing so whenever the car bumps into something, it has a lock-like system at the top that keeps them closed. To open them you just have to pull lightly.



The front hood opens, giving access to a small trunk. To open it you can of course just pull the hood up, but inside the car, in front of the co-pilot seat there is a lever that will open the hood as well.

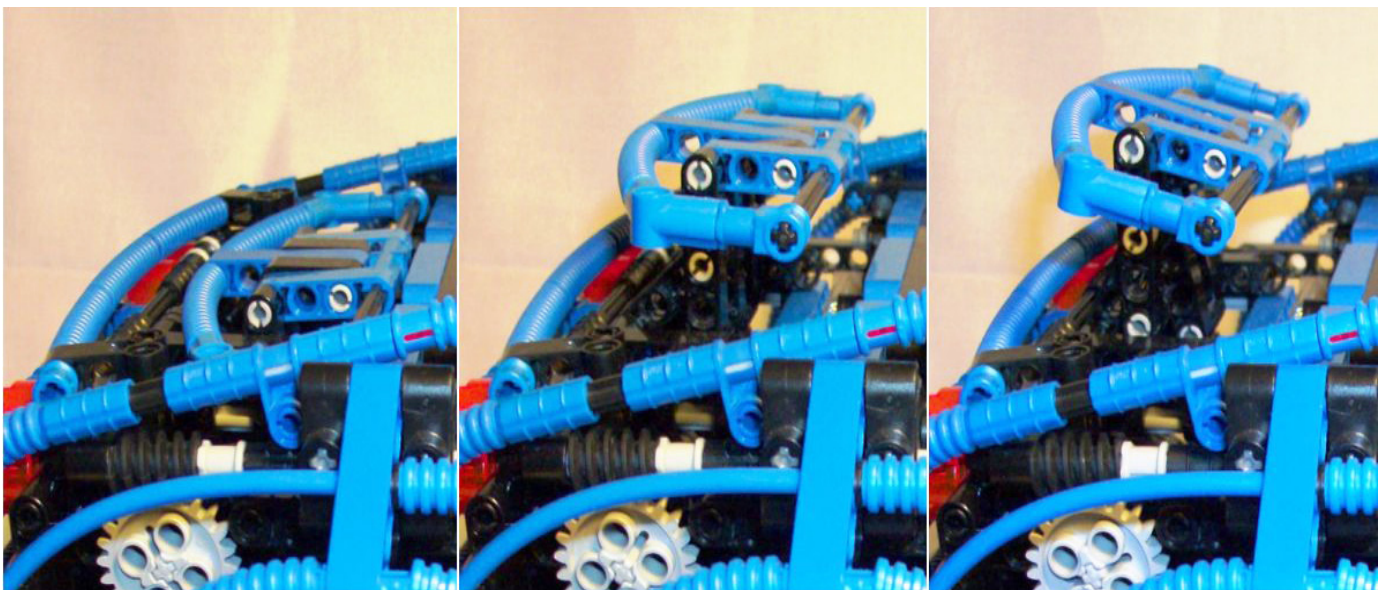
And finally, here goes the use for the previously mentioned Remote Controller 2.

The blue button is linked to the foldable top. In the real Veyron, you can attach and remove the top manually, but it has to be stored separate of the car. For my car I managed to fit the top so it can fold and hide within the car itself. In order to have the top come off properly, part of the roof and air intakes rise up to leave enough space. Once the top is out, they go back to their original position.

The red button is linked to one of the most characteristic features of the Veyron: its foldable and angle adjustable spoiler. Since I only had one motor for both actions, the spoiler is designed to go up vertically. Once it is as high as it gets, it allows you to tilt it and give it the angle you want with the same continuous movement.

Apart from that, the spoiler has one of my favourite mechanisms. If it is unfolded while you are using the friction brakes, the spoiler suddenly tilts forward, acting as a flap (just like the brakes of an airplane) helping the braking of the car, just like the real Veyron.

And now as a personal opinion about the final look of the car, I'm particularly proud of the front grill and rear bumper. I know







it might sound ridiculous, but achieving the proper angle took me many hours of work.

Well, all I have left to say is that I hope you enjoyed reading this article and seeing this car as much as I did building it. I hope I can surprise you again with new MOCs in the future.

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For more information about this MOC and others check:

<http://www.mocpages.com/home.php/32499>  
<http://www.brickshelf.com/cgi-bin/gallery.cgi?m=Sheepo#>



# Construction of modular buildings

## *The long shadow of Corner Cafe*

*Text and images by Valgarise*

### Introduction

One of the most obvious uses of LEGO® is building houses. Which fan has not built a LEGO house before or after his/her dark age? Probably very few. Moreover, this is probably the best area where the two trends in modern LEGO can be observed: The children's toy and the hobby for adults.

In my opinion, the appearance of the Corner Café marked a before and after in the construction of houses, and not because of its modular structure, which is important without doubt, but because of the richness of the model. They are houses with about 2,000 pieces, with a high level of architectural detail, and diametrically opposed to the model "for children" that consist of fewer parts and "open spaces" that have to be closed in your imagination. Obviously these models are not usually focused on children, as they are more complex to build, are priced higher and are less "playable".

The great importance of the Corner Café and its subsequent sequels is to show the potential of LEGO in this area. It's very striking to see the kind of comments this kind of construction elicits from the inexperienced public. Generally you can hear things like "I did not know that you could do this with LEGO" or "I thought that LEGO were houses with these square bricks"...

Pardon this brief introduction on the Corner Café but I want to express how important it was for me to discover this type of construction. One of the reasons that motivated my 25 year-long dark age was the proliferation of what I called "special parts" that came in the official sets. If you wanted to do something sophisticated you needed them and they were not easy to get (actually almost 25 years ago Internet did not exist). When I returned to LEGO about 3 years ago, the situation had changed and the access to these pieces showed me that they provided a wealth of possibilities for the models as can be seen in this mythical set.

In my case, several years ago I decided to build a city to accompany my Corner Café, specifically for this set and as a tribute to it, no other house in the city (or nearly none) should be an official set.

The building style I have chosen is Victorian, although with certain liberties. I have included a picture of the current state of my city:

Despite the relative complexity of the houses there is one basic premise: the city has to be playable. In fact, this city is built for my two sons and nephew to play with and at the same time play with them doing a thousand different stories. There are no "do not touch" signs, they can play as they want, and then the reconstruction brigade will come to fix the damage. The important thing is to have fun and put your imagination to work.



### Some characteristics of LEGO modular houses

Having said that, let us concentrate on the subject. The modular buildings usually are constructions with a high complexity that intend to emulate real architectural structures.

#### Say no to smooth surfaces!

I am sorry to say this but I think probably there is nothing more horrible than a smooth wall of bricks, so one of the things to consider when making a facade (at least for me) is not to build large flat areas in a single colour. If you look at the different modular buildings it is hard to find flat surfaces, and all sorts of techniques are used to avoid them: pads of different types in the CC and the Fire Brigade or bricks that are not flat (brick modified 1x2 with groove) in the Green Grocer.

Another basic resource is the variation of the depth of the facade. It's relatively simple and effective. The windows can go inside or outside the level of the main wall. The ornaments can jut out or "enter" the wall. Personally it is something I use frequently.

#### Colour Schemes

Another important factor when making a design is the colour scheme we use. It's amazing how the same model can be

changed simply by using different colour combinations. In the current models so far (we'll see in the future) a colour separation by plants is used (e.g. Corner Café) or the same scheme throughout the building but with touches of colour to break the monotony (e.g. Green Grocer, Fire Brigade or the new Grand Emporium).

Another factor to consider is the colour palette you'll use for the entire city. Personally I have major problems there, I mean.

- **Multicoloured Cities.** We've all seen cities like Amsterdam where there are multi-coloured houses, one next to the other (one red, one black, one blue ...). This is a possibility that has several advantages: you can use any bricks you have almost in any colour and it also makes the city livelier. However, this type of colour scheme causes a certain lack of homogeneity, i.e. the houses do not mix with each other and the result can be somewhat jarring (as in the case of my town).

- **Cities with limited range of colours.** In this case the result can be much more realistic and more homogeneous. If you look at the current sets that LEGO has produced you will see colours like Tan, Gray, Dark Gray, Dark Red, Brown, Green Sand ... Virtually all are very muted colours that give a realistic appearance and resemble real materials (stone, brick, wood, etc.) used in construction. Obviously the cons are that the city can be much duller, less happy and getting the bricks is more expensive.

### Volumes

A house is of course a geometric shape (or combination of various shapes) and therefore it is important to break the monotony of the model. A good example is the tower of the CC, bay windows of Green Grocer or the towers (bell and warehouse) of the Fire Brigade.

I think this is one of my pending matters. Until now I don't have a model that really satisfies me and, like most of the houses I've done are middle ones, there aren't many options to vary the volumes (at least that's how I see it).

### Some examples: inspiration and construction details

Obviously I am not an architect and I have little knowledge of architecture (I've read a couple of books on the subject that help you understand the language and identify the different elements, but very basic). As a result the way I "imagine" a house can be quite diverse. Some examples:

#### Cake shop:

In this case, the idea arose because my daughter wanted a pink house. As more than one fan knows this is a difficult colour for two main reasons: it tends to be loud and expensive.

I bought 50 1x1 pink bricks and tried to do something with them. The idea did not catch on until one day my daughter gave me 2 stickers that pointed me in a clear direction: a bakery (I previously had an ice cream shop ... note: I may have to consider making a dentist's in the future, there are excellent heads of minifigs with expressions of horror and evil doctors for the set).

Usually I first work in the front with no side walls, just a weak structure. In fact this house was unfinished for several months because I didn't have enough parts to build the sides and no idea how I wanted to build the roof. To my regret I never work with LDraw and rarely do sketches on paper so I mainly have

ideas that work directly with the parts. On many occasions parts handling gives me ideas for details. Other times I buy bricks because in my temporary mental scheme of the model they will look good, but once assembled I don't like it, ouch! That hurts doubly, my mind and my pocket!

Sometimes the lack of a type of part requires the building of alternative solutions that can result in an improvement of the initial model. For example, the cake shop would have the details in dark red but when I ordered the pieces were sold out. As I have those parts in red I changed the original plan. Fortunately I think the result was better because the lighter red gave more joy to the final model.

In this model we can find a couple of interesting details:

- The top window uses curved bricks to build the arc. I used 1x1 technical bricks to lock them to the front.
- The door frames are made using inverted plates. It's an idea I found on the internet which I think gives great prominence to the model.



#### Florist's:

This is a completely different case because I had a model to follow or adapt. The inspiration for this house came from a fridge magnet that my oldest nephew had brought from Belgium. I liked the house and I took a photo to work on it later, I include the picture:



In this case I had to make several adjustments especially in the colours (which I did not have) and the height of the house since it would have been too high compared to the rest of the city.

The technical details that we can emphasize are two:

- Relief on the first floor of the





facade. In this case gray tiles have been used as bricks. These tiles are mounted on plates that are attached to the facade with brackets. In this case depending on the colour and the regular or irregular arrangement of the tiles you can create the impression of different materials such as stone or brick.

- Roof. For the construction of the roof I chose to use flags tied together by a bar structure. The advantage of this roof is that you can get the desired angle without having to conform to the defined angles of the slope bricks. In fact, each row of flags has a different inclination.

A useful detail is that the two houses have removable floors. Instead of fixing the floors to the structure they are resting on a ledge inside, finished with tiles, so the floors can slide out. It is much easier to play with this type of flooring because there is more room for hands and the removed floor also can be used with ease. Of course it must be borne in mind that at least in my case I never build the back wall of the houses so they are easily accessible and because it saves a lot of parts.

### Shopping Centre:

In this case the design was adapted from an engraving of an architecture book showing the facade of Bloomingdales as it was inaugurated in the late nineteenth century.

The facade has a triumphal arch structure and personally I find it interesting. It was adapted to LEGO by reducing the number of modules, because if it had been taken as a whole it would have been about 52 studs wide. That is unmanageable in both space and cost.

The original design consisted of 3 floors, but once built I realised that it was too dark, and that you cannot see anything inside. Unifying the two upper

floors, with the skylight in the roof and the interior courtyard I got more light into the model. The existing support bases for the floor of the upper floor were used to place icons of the themes of the products sold in the Mall.

### Conclusions:

The use of different construction techniques, such as pads, textures and colour combinations will allow more variety to the model. If you also combine it with colours that resemble real materials (brown, dark red, gray, etc.) you will achieve a very realistic result.

The modular construction with 16 or 32 studs is very easy to combine, but you must not limit creativity to stick only to these dimensions. Sometimes you need to build with additional sizes if the façade or the distribution of the house requires it.

If you are going to design a city yourself is advisable to have a clear idea of the colour palette and the area in order to avoid later surprises.

And lastly, and most important, I encourage you to build City, it is a very rewarding activity because you can build and assemble your own stories to have a good time.

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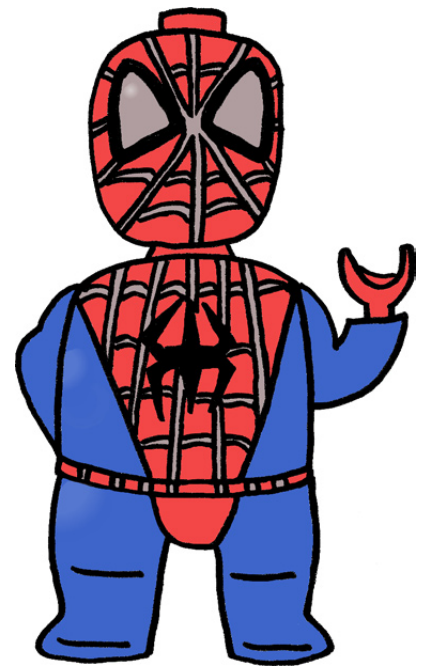


# “Holy Bricks, Batman! Superheroes and villains in LEGO®”

*One of the main characteristics of LEGO® sets, apart from their creativity and the ability to combine them in infinite ways, is their collectible nature.*

*Text by Vrykolakas and Satanspoet*

*Images by Vrykolakas, Satanspoet, LEGO® System A/S and their respective owners where noted*



Many children have spent hours and hours looking at LEGO® catalogues making plans for the future which generally ended in something along the lines of: “Someday I will have them all”. And many readers probably will be smiling right now as they remember being one of those children. Now that they have grown up and achieved an economic independence, they can get a little closer to that dream. In the universe of superhero comics something similar happens: all the fans are looking forward to completing their collection some day and adding new merchandise from their favourite series to their shelves.

With the arrival of Hollywood’s blockbusting superhero movies (and the following merchandising invasion), LEGO® decided to jump on the same wagon and create some superhero lines, which of course perfectly satisfied the collecting hunger from both groups.

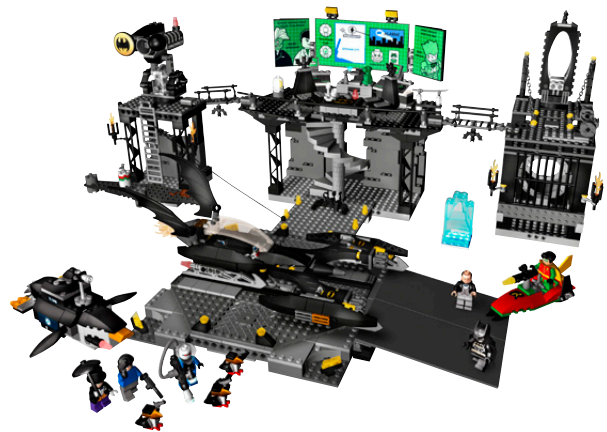
One of the best known superheroes of all time, as well as one of the oldest (created by Bob Kane in 1939) is Batman.

With irregular success through the several decades of his existence, Batman lived his golden age back in the late eighties and early nineties, catapulted to fame thanks to the hard work of many authors and Warner Brother’s blockbuster movies which led to the “Batmania” and its never ending licensed merchandising invasion. More recently, in 2005, Batman broke records yet again thanks to Christopher Nolan’s new movie saga. This time, LEGO® was one of the brands that decided to create products based on the character. Between 2006 and 2008, thirteen sets were designed. Instead of recreating any specific scene from the movies or the comics, they simply display situations and scenes the caped crusader usually gets involved in.

Before analysing the Batman sets, we have to highlight the most wanted item among the collectors: the minifigs. With exclusive heads, torsos and accessories, the minifigs of Batman and his foes are reaching higher prices everyday, and ever since the sets got out of production many people are after them. Several of these minifigs are even more expensive than many Star Wars minifigs.

The Batman sets can be classified in two groups: Dioramas and Vehicles.

There are only two Diorama sets, but they contain the highest amount of pieces out of all the Batman sets. First we have ‘**The Batcave: The Penguin and Mr Freeze’s Invasion™ (7783)**, in which we can build Batman’s secret headquarters being invaded by two of his most well-known enemies. With 1075 pieces, it soon became one of the most wanted sets by collectors. Within the set we can find many elements straight out of the comics like the supercomputers used by Bruce Wayne to fight crime, several traps and defence mechanisms and some vehicles, such as the Bat-Blade, the Penguin’s submarine and Robin’s jet-ski. It also features many other details that fans will appreciate, like the Joker’s fingerprints, or one of his bombs placed in an urn for analysis.



The second of the Diorama sets is ‘**Arkham Asylum™ (7785)**, the famous institution for the criminally insane, the one Batman’s enemies keep escaping from time and again. The set consists of some of the creepy buildings that belong to the complex, with cells prepared to contain the supervillain’s powers, surveillance towers and the main gate. We have to highlight the vehicles included in it as well, like Arkham’s ambulance, the Bat-Glider and Nightwing’s motorbike.

The second group of sets consists several vehicles in which

the heroes pursue the villains by sea, land or air. There is a total of ten sets:

**'The Batman Dragster: Catwoman Pursuit™' (7779)** is a small set with less than 100 pieces. Batman drives a stylized dragster (which can't be turned, by the way) equipped with a missile launcher and a machine gun for chasing Catwoman, who drives a motorbike customized with feline motifs.

**'The Batboat: Hunt for Killer Croc™' (7780):** A medium size set, with 188 pieces, in which Killer Croc flees on board of a small airboat (just like the typical boats from the Everglades in Florida). The Bat-Boat, which is bigger, is a two-engine boat that can be operated simultaneously by pushing a lever. Armed with missiles, it also includes a small zodiac for one minifig.

**'The Batmobile: Two-Face's Escape™' (7781):** This set of nearly 400 pieces introduces another well-known foe, Harvey Dent, a.k.a. Two Face. His vehicle is a bank van, half white half grey, just like the dual personality of his owner. It has an eject device to launch a minifig into the air. It also contains the Batmobile. It is a fair recreation of Batman's most famous means of transport, which includes, among other things, a secret rear compartment for placing gadgets and weapons.

**'The Batwing: The Joker's Aerial Assault™' (7782):** Batman's best aerial set consists of 523 pieces. It is a rather big set, and once the Batwing is fully built, it takes a lot of space. As expected, the wings can be moved to reveal secret weapons and pressing the tail of the ship launches a missile. The Joker's helicopter, in purple and green, includes a rope ladder, compartments to hide weapons and a bomb drop mechanism (made using a minifig head with an evil smile).

**'The Batcopter: The Chase for the Scarecrow™' (7786):** The second one of the aerial sets, with almost 300 pieces, introduces the Scarecrow in an interesting vintage biplane (reminiscent of the Adventurers sets) loaded with containers full of his fear gas (and some funny Halloween bombs, which are minifig pumpkin heads). The Batcopter is a flying arsenal full of missiles and guns, with a secret compartment behind the pilot's seat to place even more weapons.

**'The Bat-Tank: The Riddler and Bane's Hideout™' (7787):** This is another big one with 645 pieces. Even though there is no evidence that a Bat-Tank ever existed, here we find a solid vehicle that includes a complex movement mechanism based on Technic pieces. The set also includes Bane's sidecar, a jet-pack for the Riddler and a gate with security towers as part of a small diorama.

**'The Batbuggy: The Escape of Mr. Freeze™' (7784)** is the humblest of the Batman's sets with only 76 pieces. It contains two vehicles. Mr. Freeze appears in a small convertible with a deposit attached to his freezing gun. Batman drives a buggy with a rather ostentatious rear wing releasing a Bionicle flame. The weapon on Batman's vehicle is a harpoon launcher.

**'Robin's Scuba Jet: Attack of the Penguin™' (7885):** With 206 pieces, it's a bigger and better version of the same vehicle that is featured in the Batcave set. The Penguin's submarine, being 22 studs long, includes two propellers, big and small torpedoes and a periscope. Robin's scuba jet is a little cheery ship in green, red and yellow without any offensive power (but supposedly fast).

**'The Batcycle: Harley Quinn's Hammer Truck™' (7886):** Another set featuring a pair of vehicles, and containing 267 pieces. Harley Quinn's off-roader looks huge in comparison

to Batman's motorbike. The off-roader is decorated with the cheerful colours of the driver, and its main characteristic is a giant hammer that can be moved left and right. If we take a closer look at the vehicle we can see some more funny details, like the "I love Joker" license plate or a big red button that says "Hit me!". The motorbike has a compact and sturdy design that - yep, you guessed it right - also includes missiles to be fired.

**'The Bat-Tumbler: Joker's Ice Cream Surprise™' (7888):** The best of the vehicle sets if you ask any of the lucky owners. Its 449 pieces reveal two wonderful vehicles. The Joker's Ice Cream van hides a lethal surprise: If you open the back doors and press the giant ice cream on the roof, a missile is launched. As a curious note, the van has the same colours as its cousin from set 7639, The Camper. The Tumbler is the same vehicle shown in the Batman Begins movie, true to the model that could be seen on screen. It presents an impressive and menacing aspect, with a control panel and a steering wheel, apart from the obvious missiles.



Lastly, we have a little jewel that doesn't fit either of the two categories: **'The Batmobile UCS™' (7784)**. It is a reproduction of the famous vehicle, full of details and built with nothing less than 1045 pieces. We have to highlight the mechanism that links the steering wheel to the Batman symbol on the hood and makes it open when you steer, or the gold-coloured parts for the hubcaps.

One thing to mention is that since these sets are out of production, it has become more and more difficult to find them, and nowadays there is a big second hand market in which these sets reach three to four times their original price.

The success of LEGO®'s version of Batman increased thanks to the video game by TT Games, the developer responsible for the LEGO Star Wars™ and LEGO Indiana Jones™ games. Its great success drew many people without any previous LEGO® experience into the world of our beloved toy bricks.

Another superhero with his own LEGO® version is Spider-Man™. The license was probably obtained from Columbia Pictures™ as it featured sets tied to the Spider-Man 1 and 2 movies. There were twelve sets that hit the market between 2002 and 2004. After that, Mega Blocks® acquired the rights through Marvel Enterprises® and released toys based on the movies as well as some other characters such as Captain America, Hulk or X-Men.

In 2002, the first Spider-Man™ based sets appear under the LEGO Studios® line. The idea was to release several sets recreating the filming process as if it were some sort of "making of". The sets that hit the shelves were **'Green Goblin™' (1374)** with 50 pieces and **'Spider-Man Action Studio™' (1376)**, a set with 228 pieces. As a bit of trivia, there was talk about a third set under the name of **'Wrestling Scene™' (1375)**, but it was never released. The set was planned to be a wrestling

fight scene being shot. There were even pictures from the set, but it never came out on sale.

In 2003, LEGO Studios® disappeared, so Spider-Man got his own line. In that year LEGO® released three sets: The first one, **'Spider-Man's first chase™' (4850)** with 180 pieces recreates the first pursuit of Peter Parker as Spider-Man™.

The next one is **'The origins™' (4851)**, a set with 195 pieces in which we can relive the two key scenes from the movie: When Peter Parker and Mary Jane Watson visit Columbia University's gene lab and Parker gets bitten by a genetically modified spider, responsible for his transformation into Spider-Man after giving him super abilities. It also recreates Norman Osborn's transformation into the Green Goblin, after he tests some experiments on himself trying to keep a military contract and avoid the bankruptcy of his enterprise, OsCorp

The last one is the 345 pieces set **'The final showdown™' (4852)**, which represents the final scene of the movie in which the Green Goblin captures Mary Jane and a wagon from Roosevelt Island Tramway full of children on Queensborough Bridge. Spider-Man has to use all his resources to save Mary Jane and the children at the same time from certain death.

In 2004, the last year of the LEGO®/Spider-Man™ contract, seven sets appeared, two of them belonging to the LEGO 4+® line. A thing worth mentioning is that the minifigs that came with these Spider-Man 2 sets already came in flesh instead of the classic yellow. Also, not all the sets recreate scenes from the movie.

**'Spider-Man's Street Chase™' (4853)**, containing 61 pieces and not based on any movie scene, recreates a simple diamond robbery, with one of the two thieves fleeing on a skateboard.

**'Doc Ock's Bank Robbery™' (4854)**, with its 132 pieces recreates the moment in which Dr. Octopus tries to rob the bank in which Peter Parker and his Aunt May are at that moment. Dr. Octopus takes Aunt May as a hostage and Spider-Man goes to the rescue.

**'Spider-Man's Train Rescue™' (4855)**. This set of 262 pieces is based on the fight between Spider-Man and Dr. Octopus. After the latter destroys the brakes of the train, Spider-Man is forced to stop the now out of control train before it reaches the end of the railway.

**'Doc Ock's Hideout™' (4856)**, the most complete Spider-Man set released, with 445 pieces, recreates the old abandoned warehouse in the docks where Dr. Octopus continues his fusion experiment and holds Mary Jane captive.

**'Doc Ock's Fusion Lab™' (4857)** is a set with 201 pieces. During the sustainable fusion experiment held by scientist Otto Octavius, something goes wrong. The tentacles created for the experiment merge with the scientist's spine. He is later carried to a hospital for their removal. This is the origin of the villain we know as Dr. Octopus.

In the LEGO 4+® line, meant for children of 4 (and over) by featuring bigger pieces and figures, LEGO® released two Spider-Man™ sets: **'Doc Ock's Crime Spree™' (4858)** and **'Doc Ock's Cafe Attack™' (4860)**.

After 2004, LEGO® lost the Spider-Man™ license and the line disappeared. That is one of the reasons why nowadays the superhero related sets are so hard to find and end up with really high prices.

Something regrettable is that unlike other LEGO® licenses (Star Wars™, Harry Potter™, Batman™, Indiana Jones™) we never had the chance to enjoy a LEGO® Spider-Man™ video game.

Before finishing, we want to draw some attention to a growing phenomenon: the customization of minifigs in order to create superheroes that don't have their own official LEGO® version (and probably never will). On the Internet there are many amateur artists who upload pictures of their creations, reproducing dozens of comic superheroes and villains. Many of them just combine official pieces, but some apply custom decals on the minifig heads and/or torsos and even create their own custom pieces.

This fact highlights the great compatibility between LEGO®





and the superhero fandom, something not very well explored until now. Many fans would be really happy to add some sets based on their favourite ninth art characters.

Now just letting our minds go crazy, let's think about the possible future of superheroes in LEGO®. With the last news of Christopher Nolan directing a possible new Batman project scripted by David S. Goyer, perhaps LEGO® might release new sets based on the movie again.

And continuing with the speculation...The Walt Disney

Company® bought the Marvel Entertainment® brand in 2009, acquiring the rights of nearly 5000 characters from the comic world. In 2010, thanks to the Disney Consumer Products® license acquired by LEGO®, we get to enjoy lines based on 'Toy Story', 'Cars' and the 'Prince of Persia' movie. A fourth Spider-Man movie is planned, along with some other Marvel superheroes movies, like Thor, Captain America, The Fantastic 4, etc..., so who knows what the future will bring us? The possibilities are out there...

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Spawn by  
Dunechaser



Hellboy by  
Sir Nadroj



Wolverine by tin7



Watchmen by  
burakki62

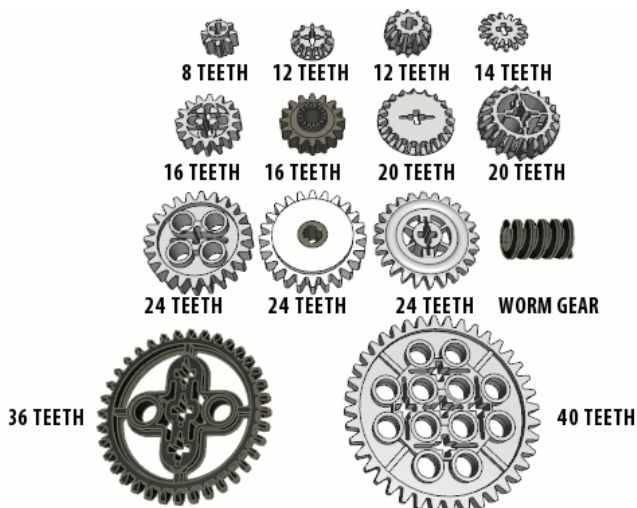


Justice Society by  
levork

# Gears tutorial

*A complete tutorial on LEGO® gears, their advantages and disadvantages as well as the basic laws of mechanics that apply to them.*

*Text and images by Paul Ian Kmiec*



When I describe my constructions or ideas, and when I explain their functionality, I usually assume that readers have a basic understanding of mechanics and of the rules that apply to gears. This assumption, it seems, is sometimes wrong. Even though it may appear frustrating at times, I see no real reason to ignore the people who have not yet learnt how the gears work, nor to deny them the pleasure of building with LEGO® Technic. Having considered this, I prepared a document in which I've attempted to cover my entire knowledge on gears in an accessible manner. The tutorial you're about to read should hopefully be useful both to beginners and to experienced builders. For better clarity it was divided into sections.

## 1. Introduction to gears

What do we need gears for? A very usual answer is: to transfer the drive from a motor to the final mechanism. This is true, but not entirely correct. The essential purpose of gears is to transform the properties of a motor to suit our purposes in the best way possible. Transferring the drive is in fact a side-effect of this process.

Gears can obviously be used with all kinds of drive, be it an electric motor, a manual crank, a wind turbine, a mill wheel, whatever. For the purposes of this document we assume that drive is provided by an electric motor, because it's a popular solution with LEGO Technic, and one with constant properties that can be transformed with gears.

Every motor has its mechanical power, specific for a given

type of motor. A number of types of LEGO motor exist, some types offering greater power than the others. The important thing is that the mechanical power of a motor consists of two factors: speed and torque. These are the two properties we can transform using gears.

Speed is simply the number of rotations of a driveshaft that the given motor produces within a given time interval. The higher the speed, the more rotations we get. In mechanics, speed is usually measured in RPM, which is Revolutions per Minute. One RPM means one revolution of the motor's driveshaft per minute – which is really slow. Most LEGO motors offer more than 100 RPM.

Torque is the strength with which the driveshaft is rotated. The higher the torque, the more difficult it is to stop the driveshaft. Therefore motors which offer high torque are usually preferred to the other, because they can drive heavier vehicles or more complex mechanisms than the motors with low torque. Torque is measured in N.cm, and all we need to know is that the more N.cm, the stronger the motor.

The mechanical power is, in a certain simplification, the quotient of torque and speed. If we increase torque and/or speed, the mechanical power will be increased accordingly. In fact, the torque of a motor is constant – it can't be changed without changing the construction of the motor. The speed, on the other hand, depends on the voltage at which the motor is powered. The higher the voltage, the higher the speed, which allows increasing the mechanical power of the motor by manipulating the voltage of its power supply. The official standard for LEGO motors is 9V voltage, which is equal to the voltage of six AA batteries. The recently released LEGO rechargeable battery provides 7.4V. It means that motors powered from the battery have lower mechanical power than the ones powered from AA batteries, but this is just theory, because the voltage provided by the AA batteries decreases over time, and the voltage provided by the LEGO battery remains more or less constant. Some experiments have been done with motors powered at 12V, and though the motors produce higher mechanical power under these conditions, it should be noted that they were designed for 9V, not 12V, and it may result in fatal damage to the motors. In this document we assume that all motors run at the same voltage, whether it's 9V or less. You can find an exhaustive description of the performance of specific LEGO motors here.

What do we need the speed and torque for? That is actually different for each mechanism. Consider a model of a sport car – we want it to be light and fast. It means that we certainly need large speed, but not the torque, because a light vehicle



requires little torque to move. Using gears, we can transform torque into speed, or speed into torque. There are two very important, but very simple rules for that:

- if we drive a large gear with a small gear, we increase the torque but decrease the speed (that is called **gearing down**)

- if we drive a small gear with a large gear, we increase the speed but decrease the torque (that is called **gearing up**)



The best thing is that we can transform part of one property to increase the other; we don't need to transform all of it. In the case of our sport car it means that we can pick a drive motor, and use the first of the aforementioned rules to gain extra speed at the cost of some needless torque. How much torque can we transform depends mainly on the car's weight, so it's a different value for every model. Experienced builders can estimate the range of possible transformation knowing just the vehicle's weight and the type of the motor used to drive it. The basic rule is: speed and torque are inversely proportional. It means that if we lose 20% of speed, we gain 20% of torque.

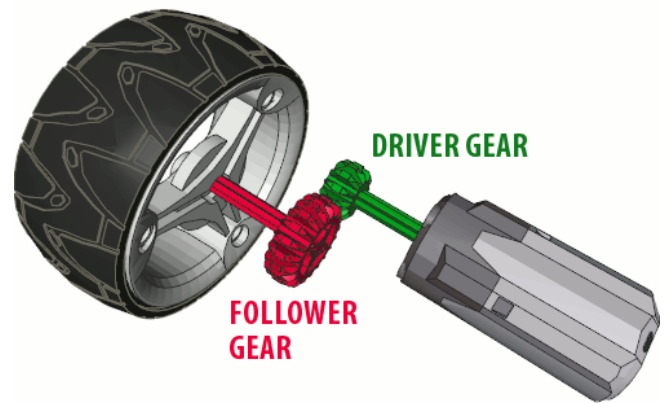
A different example would be a rail crossing barrier. We can raise or lower it with motor, but the nominal speed of any motor will be probably too large. A barrier should take at least several seconds to be fully raised or lowered, and most LEGO® motors run at more than 100 RPM. We need to use gears to get rid of this needless speed, and in exchange for that we will get extra torque, which can be used to operate a longer and heavier barrier. In this case, we use the second of the aforementioned rules.

Now that we know what gears can do, let's have some theory.

## 2. Basic rules

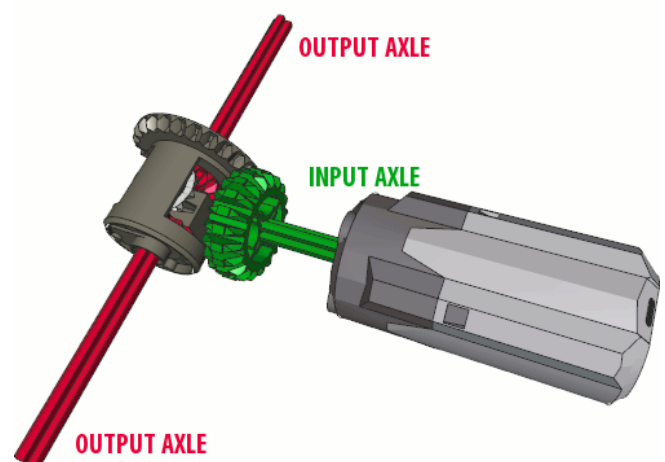
In the first section we have learned the two rules of transforming torque into speed or speed into torque. We know what to use the gears for, and now we will learn how to use them. We will need a number of notions for that.

We can talk about using gears to transform the properties of a motor when there are no less than two gears meshed, each set on a separate axle. The gear that is closest to the motor is called the driver gear. The gear that receives the drive from it is called the follower gear. In the diagram below the driver and follower gear are marked green and red respectively.

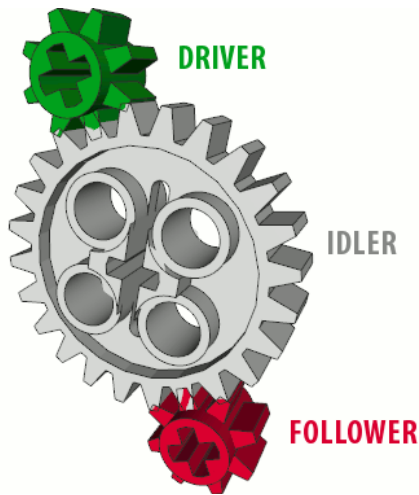


Almost every mechanism has its driver and follower gear. In every pair of meshed gears there is a driver gear and a follower gear. It should be sufficient to remember that the driver gear is the one the drive is transferred from, and the follower gear is the one the drive is transferred to.

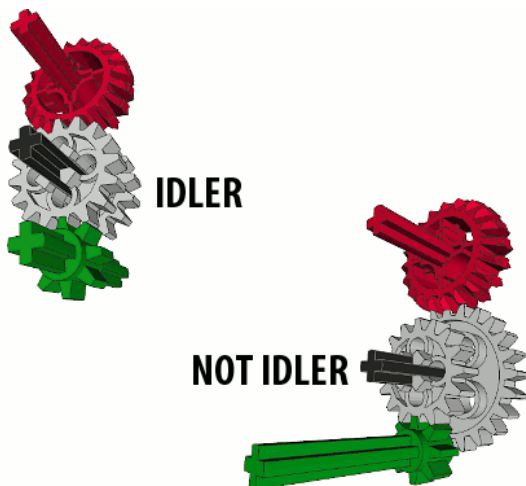
As you may have noticed, in the diagram above the axles are marked with the same colours as the gears. That is because we can talk about axles in the same manner in which we have just described the gears. In fact, many mechanisms have covered or hidden gears but clearly visible axles, so this approach is often more convenient. In this case we call the axle with the driver gear (green) an input axle, and the axle with the follower gear (red) an output axle. That's it: input and output, just like the driver and follower. Most mechanisms have a single input axle (because it's difficult to drive many input axles with a single motor), but there are multiple output axles possible. The popular differential mechanism is a good example of a one input / many outputs solution:



It doesn't end just with the driver gear and follower gear: we also have idler gears. If there is a number of gears meshed one by one, then only the first one is the driver gear and only the last one is the follower gear. All the gears in between are called idler gears, and that's because they could as well not exist. Their presence does not affect how the torque and speed are transformed: only the driver and follower gear determine that.



In the diagram above the large gray gear is meshed with the driver gear at one side and with the follower gear at the other. This is typical for idler gears: being meshed with many gears at the same time. Idler gears are usually meshed with two gears at the same time, while the driver and follower gear are only meshed with one. This is an easy way to identify idler gears, but there are exceptions.

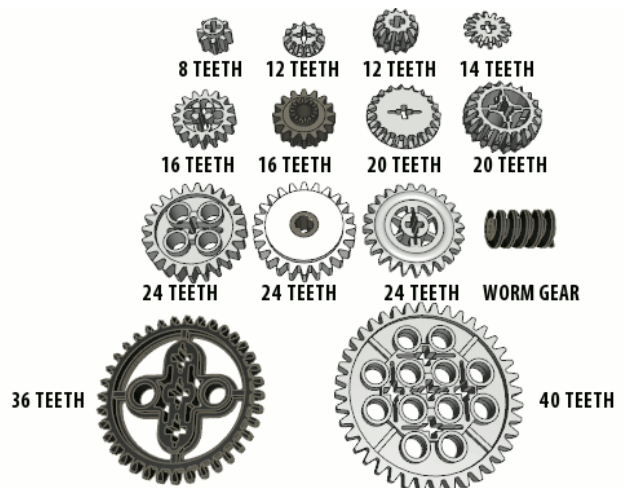


The diagram above shows two sets of gears. The left set contains a driver gear, a follower gear and two gears in between, each meshed with a single gear only. These two gears are set on the same axle, which means that they can be idler gears (not possible if they had separate axles), and they are of the same size, which means that they surely are idler gears. That is because many gears of the same size set on the same axle always act like a single gear – no matter whether there are 2 gears or 200. The right set also contains a driver gear, a follower gear and two gears in between, except these two gears are of different sizes. If they have different sizes while sharing the same single axle, they can't be idler gears. That is because the difference in their sizes affects how the torque and speed are transformed between the driver gear and the follower gear. More precisely, the size of a gear affects the torque it transfers – we see that the gears share the same single axle, so their speeds must be equal, but their sizes are clearly different.

With this classification in mind, we can now have an exact look at the types of LEGO® gears.

### 3. Types of gears

LEGO® has released various types of gears in the history of the Technic line. Below is a list of the ones that are still in use:



As you can see there are 13 classic, round gears, and there is one special gear called a worm gear. Moreover, the round gears can be divided into two groups: the regular ones with square teeth, and the bevel ones with rounded teeth. Practically any gear of the first group can be used with any gear of the second group. The unique property of the bevel gears is that they can be meshed both in parallel and perpendicular. They are also more convenient to use with liftarms because of their size. However, they are not suitable for use with the LEGO chain.

Let's have a short description of each gear on the list (bevel gears have the word bevel in their names):

**8 teeth gear** – the smallest gear currently being produced, and a very fragile one. It's not suited for high torque, but very popular, especially for gearing down (being the smallest, it is obviously the most efficient at it). There are at least three different variants of this gear, and the most sought for one is reinforced with an extra layer of plastic around the axle, between the teeth.

**12 teeth gear (a single bevel one)** – the smallest bevel gear currently being produced. It's not really useful for gearing down or up, but irreplaceable with differential mechanisms and very popular when there is a need to transfer the drive in a perpendicular manner inside a limited space. Easily broken under high torque, which led to complete absence of differentials in e.g. some trial trucks.

**12 teeth gear (a double bevel one)** – the smallest double bevel gear currently being produced. It's much stronger than its single bevel counterpart, and is most usually used together with a 20 teeth double bevel gear.

**14 teeth gear** – the predecessor of the 12 teeth single bevel gear. It was the first gear designed specifically for differential mechanisms, but proved so very fragile that it was later replaced by the 12 teeth version. It is no longer used in the official LEGO models and is unpopular with builders.

**16 teeth gear (a regular one)** – a reasonably strong and useful gear. This is the smallest gear that can be operated with



LEGO chain, and a popular one thanks to its convenient size.

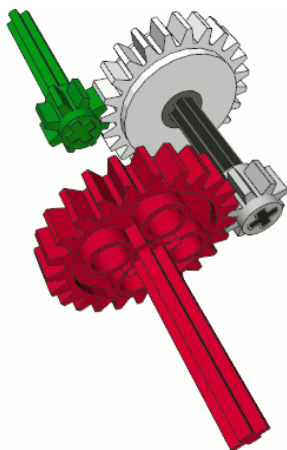
**16 teeth gear (with clutch)** – available almost exclusively in dark gray, a gear designed specifically for gearboxes. It's weaker than the regular version and doesn't work well with LEGO® chains (it has a tendency to slip on it because of shorter teeth). Instead, it has the unique ability to be engaged or disengaged by the transmission driving ring. Without the ring, it remains loose on the axle, but it can be meshed with an old-type halfbush (the one with teeth) and thus get fixed to the axle.

**20 teeth gear (a single bevel one)** – larger version of the 12 teeth single bevel gear. Rare and not really popular because of its thin body which makes it snap under high torque. Usually meshed with a 12 teeth double bevel gear or 20 teeth double bevel gear.

**20 teeth gear (a double bevel one)** – very popular, strong and reliable gear. Most commonly used together with a 12 teeth bevel gear, but useful in different setups too.

**24 teeth gear (a regular one)** – another popular, strong and reliable gear. There are at least three different variants of this gear, the newest ones being the strongest ones. One of the most useful gears ever.

**24 teeth gear (with clutch)** – a specific version of the 24 teeth gear, not related to the 16 teeth gear with clutch. It's always white and either dark or light gray in the middle and it has the unique ability to harmlessly slip around the axle if a sufficiently high torque is applied. It makes it a very useful and sought for gear, although a rare one. Most usually it is used for end-to-end applications, that is, applications where a motor can only run until it reaches a certain point. This includes for instance almost all steering mechanisms, where the wheels can be turned only at a limited angle, or the aforementioned railroad barrier mechanism, where the barrier can be only raised or lowered to some degree. In this type of mechanisms this gear slips when that end point is reached, so that the motor can continue to run while the mechanism is stopped. Another example are winches in the official LEGO sets with motorized winches (e.g. 8297), where this gear is used to make sure the motor doesn't get damaged when the end of the string is reached. Please note that this gear slips under a very specific amount of torque – and in most cases you will want it to slip only under extremely high torque (e.g. to make sure that the steering mechanisms stops turning when the end point is reached, not when a wheel meets an obstacle). This can be achieved by using this gear right after the driver gear:



Thanks to Jetro de Château it is confirmed that there have been at least three versions of this gear released over the

years (photo courtesy of Jetro de Château):



From left to right, these are:

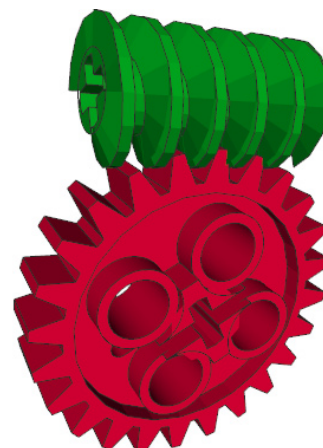
- version that came with the 8479 set, it has a light gray centre and require more torque to slip
- version that is most commonly used, with dark gray centre
- version from an unknown set(s), with smooth sides (no clutch power indications)

**24 teeth gear (with crown)** – a really old design, the first gear among the regular gears which could be meshed in a perpendicular manner. Again, there are at least three variants of this gear. The older and weaker ones have gradually been replaced by never and stronger versions. The arrival of bevel gears made it one of the currently most unpopular gears; it's weak and inconvenient to use. Still, it can sometimes be useful due to its unusual shape.

**Worm gear** – a gear with a number of unique properties. Firstly, it can only be used as the driver gear, never as the follower gear. It comes in handy for mechanisms that need to e.g. lift something up and keep it lifted; in this case the worm gear acts like a lock that keeps the desired part of a mechanism lifted without putting its load on the motor. There are a lot of possible applications for this property of the worm gear, for instance many types of cranes or forklifts, railroad barriers, drawbridges, winches, and basically any mechanism that needs to keep something steady once the motor stops.

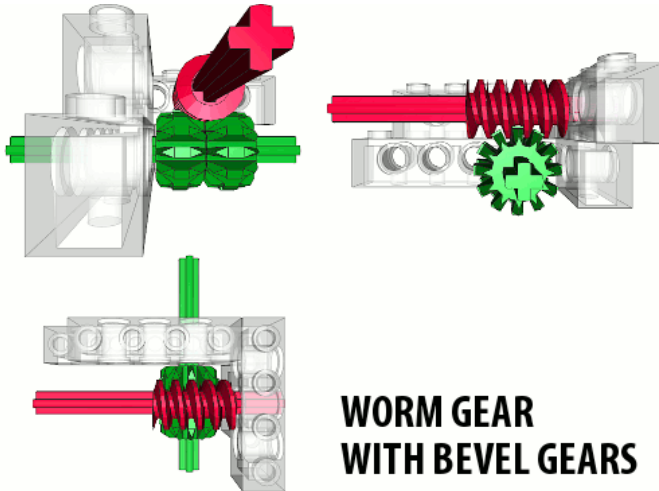
Secondly, the worm gear is extremely efficient for gearing down. It is theoretically 8 times more efficient than the 8 teeth gear, because every revolution of the worm gear rotates the follower gear by just a single tooth. Therefore worm gears are used for gearing down whenever there is a very high torque or low speed needed and there is little space to use.

Finally, as the worm gear rotates, it has a tendency to push against the follower gear and slide along its own axle. Usually this tendency has to be stopped by a strong casing around the worm gear, but there are certain mechanisms that use it to



move a worm gear from one place to another, for instance my pneumatic autovalve or my automated trafficators system.

The worm gear can be used with all the listed gears. The most common use is to mesh it with a 24 teeth gear: But it can be easily used with any other gear. You can see some examples of worm gears enclosed with follower gears inside strong casings [4]. With proper spacing, it can be used with bevel gears too:

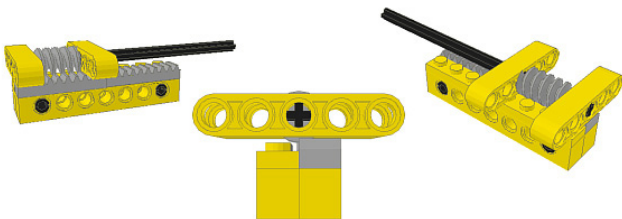


### WORM GEAR WITH BEVEL GEARS

In the diagram above, two 12 teeth double bevel gears have been used. But it can be just a single double bevel gear, or two single bevel gears, or even just one single bevel gear. It's even possible to use the worm gear to drive racks, which may result in e.g. a very compact boom extending mechanism:

#### WORM-GEAR-ON-RACK EXTENSION

ONE OR TWO ROWS OF RACK CAN BE USED.  
THE WORM GEAR MUST BE BRACED BETWEEN LIFTARMS,  
NOT BETWEEN BRICKS, TO OBTAIN PROPER SPACING  
FROM THE RACK



**36 teeth gear (a double bevel one)** – the largest bevel gear currently being produced, and the only one with no single bevel counterpart. A convenient and surprisingly strong gear, but a rare one. Usually comes in black.

**40 teeth gear (a regular one)** – the largest regular gear currently being produced. Rarely used because of its immense size, but sometimes really useful.

That concludes the list of gears we can usually choose from (there are some outdated gears, but they are so unique that I have actually never had any in my hands). Now let's see why the size of gears matters.

#### 4. Gear ratios

According to Wikipedia, the gear ratio is the relationship between the number of teeth on two gears that are meshed or two sprockets connected with a common roller chain, or the circumferences of two pulleys connected with a drive belt. We will not deal with pulleys in this document, and the ratios for sprockets connected with a common chain are exactly the same as for the gears that are directly meshed. Hence a gear ratio is simply:

$$\text{number of follower's gear teeth} / \text{number of driver's gear teeth}$$

Since the spacing between the teeth of each gear is equal, counting the number of teeth is a simple mean of calculating the circumference of a gear. And the gear ratio is basically the relationship between circumferences of gears.

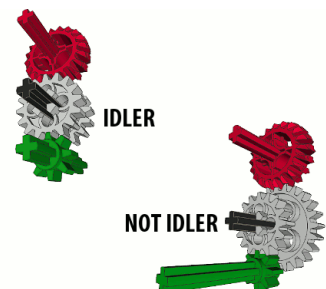
What do we need the gear ratio for? Basically to easily calculate the final speed of the mechanism and the torque it provides. Consider an 8 teeth driver gear and a 24 teeth follower gear. We know from the section 1 that this is gearing down: we gain some torque, but we loose some speed. The gear ratio is 24:8, which is equal to 3:1. Please note that it is a common practice to calculate ratios in such a manner that they end with 1. Why? Because from looking at 3:1 ratio we can easily tell that it means that the revolution's speed is reduced three times, which means that three revolutions of the driver gear / input axle result in a single revolution of the follower gear / output axle. Since the decrease of speed results in an inversely proportional increase of torque, we know that torque is increased three times.

Consider an opposite example: we have a 20 teeth driver gear and a 12 teeth follower gear. The gear ratio is 12:20, which is equal to 0.6:1. It means that we need 0.6 revolution of the driver gear to get a single revolution of the follower gear. Hence we gain 40% of speed, but we lose 40% of torque.

As you may have noticed, it is easy to tell gearing up from gearing down looking at the gear ratio. If the first number of the gear ratio is greater than the second (like 3:1), this is gearing down – also called a gear reduction. If the first number of the gear ratio is smaller than the second (like 0.6:1), this is gearing up – also called a gear acceleration or an overdrive. If we have 1:1 gear ratio, speed and torque remain the same, just as if we used idler gears.

We can already calculate the gear ratio of two meshed gears, but what if there are more gears in the mechanism? In this case, we ignore all the idler gears and calculate ratios for all pairs of driver/follower gears. Then, in order to get the final gear ratio of the entire mechanism, we simply multiply these gear ratios. Consider a mechanism from section 3, with two pairs of 8 teeth drivers and 24 teeth followers.

The gear ratio of the first pair is 3:1, and so is the ratio of the second pair. If we multiply these ratios, we get a final ratio equal to 9:1 – which is true and accurate.



Now that we can calculate gear ratios, let's go back to the example of idler and non-idler gear from section 2:



Consider the left set of gears. It consists of two pairs of gears: an 8 teeth driver gear with a 16 teeth follower, and a 16 teeth driver with a 20 teeth follower (let's assume we don't know if there are idlers in this set yet; we calculate ratio of each pair separately). The ratio of first pair is 2:1, and the ratio of second pair is 1.25:1. If we multiply these, we get the final ratio equal to 2.5:1, which is equal to 20:8 – that is the ratio of the first and the last gear only. As you see, the idler gears did not change the ratio at all, and this is why we can ignore them.

Now consider the right set of gears. It consists of another two pairs of gears: 8 teeth driver gear with 16 teeth follower gear, and 24 teeth driver gear with 20 teeth follower gear. The ratio of first pair is again 2:1, but the ratio of the second pair is 0.833:1. If we multiply these, we get the final ratio equal to 1.66:1 – which is not equal to 2.5:1 (the ratio of the first and the last gear only). Here the middle gears were not idlers, so they affected the final gear ratio of the whole set and they couldn't be ignored.

Finally, how do we calculate the ratio if a worm gear is used? Well, that's even simpler:

*number of follower's gear teeth / 1*

And that's because, as was mentioned before, a single revolution of a worm gear rotates the follower gear by a single tooth. Therefore it takes 24 revolutions of the worm gear to rotate a 24 teeth gear once, and hence we get the ratio 24:1 which is true.

You can use this calculator to calculate the ratios of your LEGO® mechanisms.

## 5. Efficiency

We had some theory, now we need to get back to practice, which is unfortunately a bit sad. Every gear we use has some weight and generates some friction that has to be overcome if we want the gear to rotate. Hence every gear in our mechanism uses part of the power of the drive motor, and the efficiency of the gear tells us how much power is transferred and how much is lost. Unfortunately, it's extremely difficult to calculate the individual efficiency of each gear, and as far as I know there are no reliable specifications for the efficiency of LEGO gears. But we know how the power is lost, so we can safely assume two basic rules for maximum efficiency:

- *the fewer gears, the better*
- *the smaller gears, the better*

Sadly, this means that e.g. a gear ratio equal to 1:1 is only theoretical. If there are gears, there are losses, so the real ratio has to be 1.something:1. The only mechanism in which the 1:1 ratio is possible is a motor connected directly to the final gear – for example in my model of Leclerc T6 tank, where the drive motors were connected directly to the wheels in order to achieve 1:1 efficiency.

What about gear acceleration? Yes, you can obviously use gears to get e.g. a 1:6 gear ratio which will greatly increase your speed. However, the quotient of your final speed and torque will be smaller than the quotient of the original speed and torque of the motor, because of the losses. Using gears always generates losses; therefore if you want to transform the speed and torque of a motor, you have to keep in mind that some of it will be lost.

There are two cases of mechanisms in which the efficiency

is crucial. First is a gearbox with transmission driving rings. This type of a gearbox uses a number of 16 teeth gears with clutch, and while all of these gears are driven, only some of them transfer the actual drive. It means some of these gears – most of them, if the gearbox has more than 4 speeds – use the power of the motor for nothing. They are so-called dead gears, which is even worse than idler gears because idler gears are usually needed to transfer the drive from one place to another, while dead gears are not needed at all. And they can't be removed from such a gearbox, because every gear selected uses a different set of gears to transform the drive. It means that a certain gear can work as a dead gear in 1st, 2nd and 3rd gear, but is needed to transform the drive in the 4th gear. A gearbox with many dead gears always performs better at lower gears, when there is a large gear reduction – it makes the drive motor use little of its power to actually do its primary task, so it has plenty of power to drive the dead gears. You can see from the video of my 10-speed manual gearbox that the motor becomes more and more strained as gears are shifted from 1st to 2nd, then to 3rd and so on. In fact, some time after this gearbox was published I built a 14-speed version, just out of curiosity. When I connected it to a PF XL motor, it was stalled and could not drive the gearbox even in 1st gear despite its excellent torque.

The second mechanism is... a worm gear. As mentioned before, a worm gear is popular because it offers an extremely high gear reduction. But this is actually the worst gear in terms of efficiency – some sources estimate that it loses almost one third of the power of the motor due to high friction (friction is the very reason why a worm gear can't be a follower gear) and its tendency to slide along its axle. The friction is high enough to make worm gears hot if they handle high torque for a prolonged period of time. Worm gears are irreplaceable for some applications, but in general they should be only used when necessary.

## 6. Backlash

Gear tooth backlash is generally a complex issue (more at Wikipedia). For the purpose of LEGO mechanics we can simply assume that backlash is the free space between the meshed teeth of two adjacent gears. In a perfect situation there should be no free space at all, and the teeth should have full contact with each other. This situation is unfortunately very difficult to achieve with standard gears (it's much easier with helical gears, but these are absent in the LEGO Technic world), and LEGO gears always generate some backlash. The general rules are:

- *regular gears generate much greater backlash than the bevel gears*
- *the smaller the gear, the greater the backlash*
- *the backlashes of any two meshed gears sum up*

You can easily guess that the 8 teeth gear is real dynamite when it comes to generating backlash. Out of all the regular gears, the 40 teeth one generates the smallest backlash. Among the bevel gears, differences are much smaller due to a different teeth design – any bevel gear generates a backlash several times smaller than in case of the feared 8 teeth gear. As pointed out above, the backlashes of meshed gears sum up. Therefore it's a good idea to use regular gears together with bevel gears – the resulting backlash will be somewhat reduced.

How does it work for a worm gear? Again, this gear proves unique, generating practically no backlash. It doesn't mean that mechanisms with the worm gear have zero backlash

– unfortunately, they still have backlash of the follower gear. Therefore a mechanism with a worm gear and a 16 teeth follower gear will always have greater backlash than the one with a worm gear and a 24 teeth follower gear. And again, it is recommended to use the worm gear with bevel gears due to their relatively insignificant backlash.

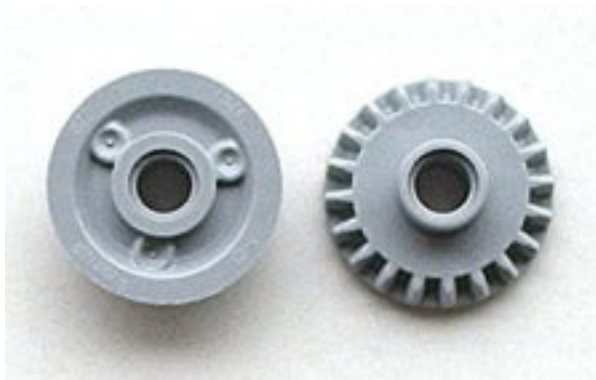
Why is backlash bad? Consider a steering mechanism with big wheels, driven by a motor reduced 27 times, which means that three pairs of an 8 teeth driver gear and 24 teeth follower gear have been used. Three 8 teeth gears together generate a backlash so large that it will not only degrade the accuracy of steering, it will also make the steered wheels have some margin of freedom, so that they can e.g. turn a bit when they meet an obstacle.

Backlash is usually not a real problem for vehicles (except for the very large ones), but it's troublesome whenever accuracy is needed. Many sorts of e.g. cranes, drawbridges or turntables suffer from backlash. The best way to avoid it is to consider the use of pneumatics instead of mechanics, or the use of linear actuators which currently have the least backlash out of all the mechanical parts produced by LEGO®.

I hope you have found this tutorial useful, and that it helped you to enjoy the LEGO Technic world a little more.

## 7. Appendixes

**Appendix A:** gear 20 teeth bevel with pin hole, knob wheel, and differences between three 8t gear types

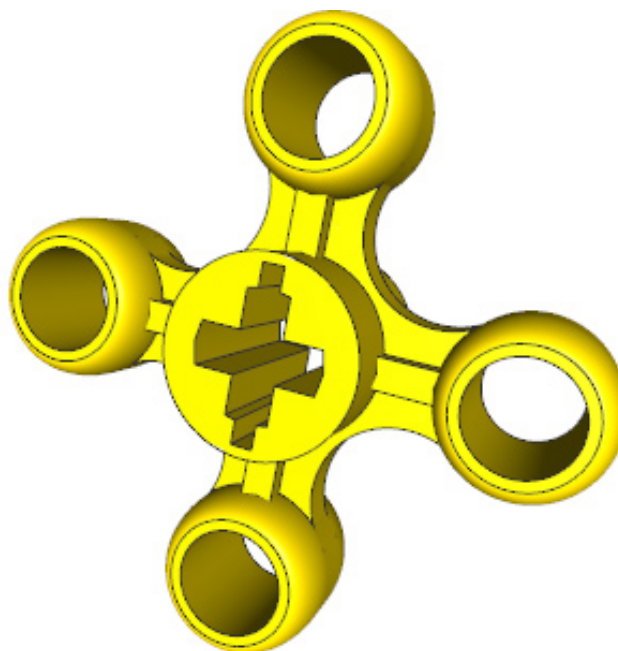


In 2010 a new type of gear was introduced: the gear 20 teeth bevel with a pin hole. It was, as you can easily see, a modification of the earlier gear 20 teeth bevel, intended to offer some new possibilities, not to replace it. These possibilities are most obvious with linear actuators: the problem with actuators is that when they are attached to an axle using the articulated bracing, they sit on the same axle that drives them. This means that the load on an actuator generates friction on the axle that drives it, and it results in its efficiency degrading rapidly as the

load increases.

The new gear appears to be designed specifically to solve this issue. So far it was possible to transfer drive to an actuator in such a setup using a gear 12 teeth single bevel or a gear 20 teeth single bevel – now we have a third option. The difference is that the new gear rotates freely around the axle, so it can be used as an idler gear without the need to actually rotate the axle it sits on. Therefore the load on the linear actuator no longer affects the efficiency of gears that drive it. This picture illustrates the three set-ups, with the new gear being the third one (please note that all three set-ups offer 1:1 gear ratio)

The new gear is also thicker, thanks to a half-stud thick collar at its base. The earlier 20 teeth single bevel gears have been known to easily snap under torque because they had only a limited contact with the axle, and the collar in the new gear helps greatly. The new gears are much less likely to snap, and their only disadvantage is that because of their pin hole, they can only be used as idler gears.



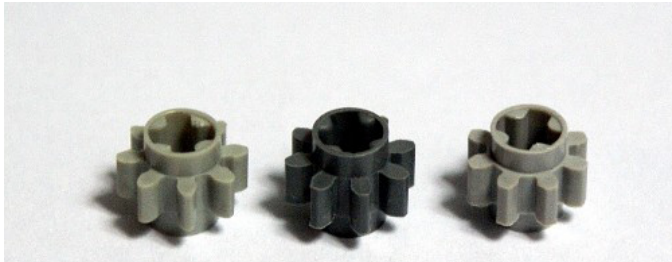
The knob wheels have been around for a couple of years – they were omitted from the tutorial earlier because technically they're not gear wheels. There are two important things to know about the knob wheels: firstly, they only mesh with another knob wheel and secondly, they are much stronger than gear wheels and they can handle significantly higher torque. The latter property makes them popular among e.g. the Truck Trial builders. Knob wheels can be meshed both in perpendicular and parallel manner. They are most commonly used in the perpendicular set-up, because the regular gears that can transfer the drive in such a set-up are much more likely to snap under torque than the knob wheels. A good





example of usage of knob wheels is the 8421 LEGO set, where they were used to operate transverse outriggers, which involves a significant torque. The disadvantage of the knob wheels is that for most of the time they are only meshed at one point (two points in the parallel set-up), and that this point changes four times per a single rotation. Therefore they work like a gear with only 4 teeth, that is: they work unevenly. This is particularly apparent when a large torque is applied to a perpendicular set-up of knob wheels – their speed of rotation starts to fluctuate. Also, because of having all the torque applied to so few points, the knob wheels are prone to wearing out. It is a common thing in Truck Trial vehicles to see the knob wheels rub away at their meshing points – but it only happens with really heavy vehicles and only after a while.

Finally, the three types of 8 teeth gears that were mentioned in the tutorial. LEGO is known to make small modifications to its moulds over time, and many LEGO parts have slightly changed their shape over the years. It's difficult to sort out the chronological order of changes affecting the 8 teeth gears, but it seems that the strongest version was introduced as the last one and is commonly used in the recent Technic sets. Please note that this is just a supposition: there's a chance that several variants of the same parts are still produced from various moulds, and that a specific set may contain one type or the other, or even a mix of both.



The gear on the left seems to be the initial variant of the 8 teeth gear. The middle gear, that was introduced some time later, has the same central part but a different shape of the teeth: they are shorter and thicker, and presumably stronger. This is a minor difference, hard to notice until you put two variants of this gear together. The third gear represents the apparently 'current' variant. It maintains the shape of the teeth introduced in the middle variant, but its central part has an apparent extra layer of material between the teeth, adding to its thickness. This is quite a noticeable difference, and is probably intended to prevent the teeth from bending under torque. This variant of the gear is the most sought for by any builder aware of these differences.

- [1] <http://www.philohome.com/motors/motorcomp.htm>
- [2] Pneumatic Autovalve: <http://sariel.pl/2008/12/pneumatic-autovalve/>
- [3] Automated trafficators system: <http://sariel.pl/2009/09/automated-trafficators-system/>
- [4] <http://sariel.pl/2009/06/worm-gear-casings/>
- [5] [http://en.wikipedia.org/wiki/Gear\\_ratio](http://en.wikipedia.org/wiki/Gear_ratio)
- [6] <http://sariel.pl/tools/ratios/>
- [7] <http://sariel.pl/2009/08/leclerc/>
- [8] <http://sariel.pl/2009/01/10-speed-manual-gearbox/>
- [9] [http://en.wikipedia.org/wiki/Backlash\\_%28engineering%29#](http://en.wikipedia.org/wiki/Backlash_%28engineering%29#)

*¿Have you found it interesting?*

We would like this article to be the first of a series of articles found among the broad AFOLS community throughout the internet, that may be of interest to the community due to their quality and that can find a new way to make themselves known to new audiences.

If you have written a tutorial about LEGO or you have found it on the internet and you think it is of interest to our community, just send us the link to [info@hisfabrickmagazine.com](mailto:info@hisfabrickmagazine.com)

We need you  
#

# Building trees (VI)

*In a forest, not everything you can see are trees. There are also bushes and thickets.*

*Text and images by Legotron*

We seek to build new elements for our forest in order to complement the tree formations that we have been seeing and building in previous articles. One element we lack are the bushes and small shrubs that grow in the shade of trees or on the edges of roads. To make it easier to find the necessary parts, the design was made using the same parts that have been used in the construction of the trees. Moreover, given the simplicity of the elements, we will make two variations, one for bushes and another for thickets. The bushes, with a height lower than a minifig, are designed for use on roadsides and surrounding areas with trees. Bushes, with a height slightly larger than a minifig, are designed to be placed next to the trees, so as to make the forest more luxuriant.

## Parts required.

On this occasion, the list of parts required, named following the Bricklink [1], naming conventions, will be incredibly easy, and we will divide it for each of the two elements that we will build:

### For the bush:

- 1 dark green plate 4 x 10.
- 1 brown brick arch 1x5x4.
- 15 green plant leaves 4x3.



### For the thicket:

- 1 dark green plate 4x8.
- 3 brown bricks 1x1 modified with headlight to hold the leaves.
- A dozen green plant green 4x3.



## Construction.

**Bush:** As you can see we kept it really simple, with a plate, a brick arch 1x5x4 and leaves we have everything we need (figure 1). The construction process is also very simple. Place the brick arch 1x5x4 near one end of the plate, so that the tip points to the other side of the plate. Place leaves on all the available studs on the trunk, each one pointing in a different direction. Then, starting with lowest of the leaves, extend the leaves adding another 1 or 2 additional leaves, connecting them below the first one and placing them so that these extensions are made to turn around the trunk. On the next level repeat the process, but turning the extensions in the opposite direction, so that the trunk is well covered. Once you have finished this step, you can add a couple more leaves to customize the bush leaving it well covered on all sides. There are many ways to make more unique customizations such as a representation of a bush in a windy area, making every branch point in the direction of the end of the trunk. These bushes are very simple and easy to make, and placing a small number of them along with a couple of trees can get the feel of a fairly leafy forest.

**Thicket:** The other element is as simple as the previous. You only need a plate, several modified bricks 1x1 with headlight and a number of leaves (photo 2). The construction of the thicket is fun and gives you endless possibilities, despite the small number of pieces. The first most important step when deciding its application is to place the bricks modified 1x1 with headlight on the plate. It is the way we place these bricks which will determine the shape, and therefore the use we can give to the bush:



- If you want to build a fence or a wall of demarcation just put all the bricks on the same line, and orienting the stud side toward the long edge of plate.

- If you want to build a bush on the boundary of a path, you can place the bricks on the same line, but randomly turning the bricks slightly.

- If you want to build a thicket for a wooded area you can put bricks in different rows each one with a different orientation, in a jumbled way.

In the first two cases with many more parts you will be able to build roads, with their bends, just placing the bricks into position beside the road and with right orientation. Once the bricks are placed you continue with the placement of the leaves. This process is what will give the desired finish to our thicket. For each of the cases mentioned above the process of placing the leaves process is different.

- A hedge needs a complicated process. Depending on the distance between the bricks, 3 or 4 studs is best, we will have the height for the entire hedge. First you place the rear side, with two leaves on each brick, the first slightly tilted to one side and pointing upwards and the other at its end, on the inside of the fence, pointing down and slightly tilted to the other side, down to the next brick. In this way you complete the entire length of the hedge. The next step is to place the leaves on the front of the front hedge, in the same way but inclined in

the opposite direction. Placing the leaves is complicated as there is only an exact position in which all of them fit perfectly. Joining several sections, we have a perfect hedge to separate gardens.

- In the case of the thicket that borders a forest or a road, the process is different, because the leaves are placed randomly on the bricks, at different angles. Since the bricks are aligned but with different orientations, you get a well defined separation that has a wild look which is perfect for our purpose. Additionally, you can add some flowers and some cherries in order to make it look like a rose or mulberry bush.

- Finally we have the thickets in the forest, which should be built with the biggest possible disorder, trying to vary the tilt of the leaves to get different heights. These thickets can be made building separate groups or a single heterogeneous group, and can be used together with other trees to achieve lush forests which look impenetrable.

With these two elements we have a simple way to give a more appealing look to our forests, roads and gardens.

References:

[1] Online portal for Unofficial LEGO® parts sales: <http://www.bricklink.com>

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# LDraw Tutorial (VII)

## Interview with Michael Lachmann

Text by Jetro

Images by Michael Lachmann and Philo

Good news for MLCad users: after a silence of several years, only a few weeks ago a new version of this program has been published, MLCad v3:30. In order to celebrate this landmark, Hispabrick Magazine has been able to interview the creator of this tool, Michael Lachman. It will shed some light on this update and the future that lies ahead for MLCad

### Interview with Michael Lachmann

**Hispabrick Magazine:** To start off, please tell us something about yourself.

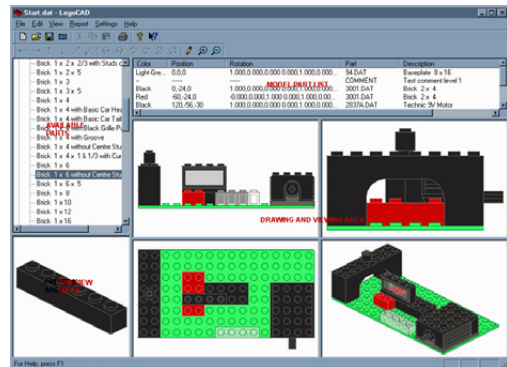
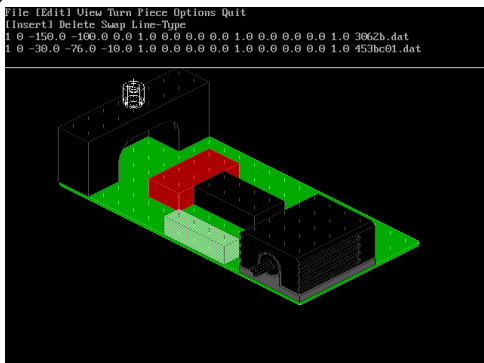
**Michael Lachman:** I'm 44, married and have one 9 year old boy called Florian. I live in Vienna, the capital city of Austria which is in Europe. I work in a local dependence of an international mobile operator Telekom. I'm responsible for a team which coordinates the software development itself and the processes around software development within the company.

**HB:** How did you first get involved with LDraw?

**ML:** This was long time ago, somewhere in the 90's when I was collecting LEGO® trains. I built some trains and cars myself and therefore was looking for software to keep the idea of these creations. That was when I found the original LDraw software for Dos and some tools around it to display LDraw files.

**HB:** What was the first version of MLCad like and how has it evolved over the years?

**ML:** The first version of MLCad was just an attempt at developing software to display ldraw models myself - it was just for fun to program something like this. When this program was finished I had the idea of extending its functionality for editing such files. The basic functions provided were those provided by the original ledit tool but with the still existing split views of the model including the side bars to select parts. Here you can see a picture of the main window of version 1.0 from July 1999.



**HB:** What has made you pick up development of MLCad again?

**ML:** There simply was a time slot to do developments on MLCad. This doesn't mean that I will do frequent continued development from now on, because this is based on the spare time I have left. But I will try to keep some time left for MLCad.

**HB:** Can you tell us something about the improvements in the latest version?

**ML:** The newest version has a changed colour handling which is based on the colour definitions in the Idconfig file. The rest of the colour handling is identical with one exception: The so called dithered colours, a fine mixture of two different colours near to each other (a method to virtually provide more colours when only 16 colours were available), are no longer supported by MLCad. That doesn't mean you can't use them, but MLCad draws a calculated mixed solid colour instead, and you cannot define dithered colours from within MLCad. Other changes were quite small, like to not suppress empty lines from the input file when part editors were editing their files, an updated MLCad.grp file and some error corrections.

**HB:** Can you explain the advantages of these changes?

**ML:** The wider range of default part groups in the new installations makes life easier for new users; the colour thing is just to support the new colour standard of LDraw.

**HB:** How do you see the future of MLCad?

**ML:** The near version of MLCad will again change the way of how to deal with colours, but with some nice features for the users. Generally users will not be able to change the standard colour palette – this is to be defined from within Idconfig – but users will have the option to define even more colours than until now and use them in their creations. I also have some plans to improve the handling of zooming

and scrolling. Finally, have ideas on how to improve the speed of MLCad by supporting multiple core cpu's in the future.

**HB:** Aside from your involvement in LDraw, are you involved in building with real bricks?

**ML:** Playing with LEGO® got very rare in the mean time; my son is more interested into my present hobby – model trains in N scale (1:160) – and in playing with other modern electronic stuff like Wii. The sad thing is that I really tried to convince him to play with LEGO but none of his friends did and so he just played to make his father happy...  
For myself there is no time left to build with real bricks - the time left is invested in my model railway – you can see it on my website [1] (German language only).

Michael Lachman has highlighted some of the new features in this version of MLCad. Among these is a different colour management. Until now MLCad used its own colours, but on 28 July 2009, The LDraw Steering Committee presented a new version of Idconfig.ldr. [2] This file has the following characteristics:

- \* 100% backwards compatible with the old LDConfig.ldr file
- \* Uses LEGO RGB values
- \* Uses LEGO numbering where possible
- \* Lists the matched LEGO name
- \* Uses Bricklink names
- \* Contains all colors currently listed at Bricklink
- \* Colors are listed in alphabetical order
- \* New color definitions for "Glitter" and "Speckle" as defined by the LSC

Besides the intended purpose of this file was to unify the way the different LDraw related applications used colours. To this end it was requested that applications use Idconfig.ldr for their colour definitions.

The format of this file is really simple. Below you can see an extract that shows how the official numbering is associated to the each colour, of which the LDraw number and values for element and border colour are given.[3]:

```
0 // LEGOID 26 – Black
0 !COLOUR Black CODE 0
VALUE #212121 EDGE #595959

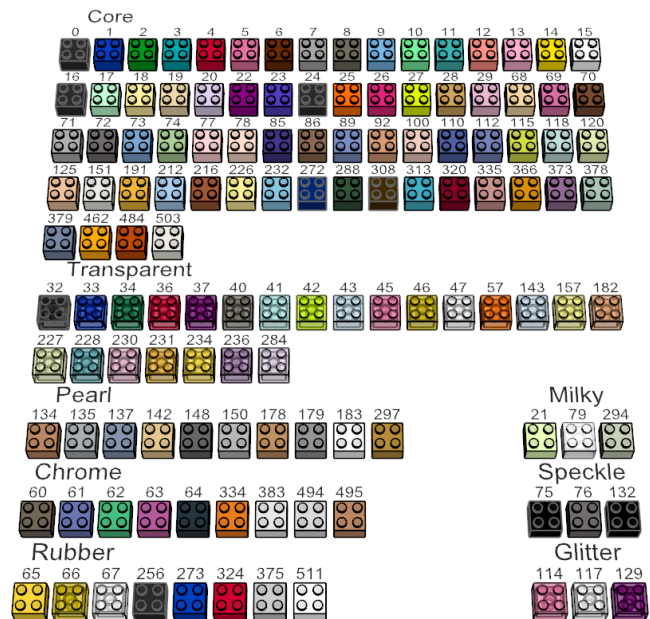
0 // LEGOID 23 - Bright Blue
0 !COLOUR Blue CODE 1
VALUE #0033B2 EDGE #333333

0 // LEGOID 28 - Dark Green
0 !COLOUR Green CODE 2
VALUE #008C14 EDGE #333333
```

In addition, this file can be translated and is as a matter of fact already available in English, German and Italian [4]. The new colour selection interface for MLCad allows you to select a colour from a list sorted by numbers as well as from an alphabetically sorted list for which a translated Idconfig.ldr file can be a great advantage..

You can see a render with each of the colours of the present

Idconfig.ldr file together with its corresponding number (by kind permission of Philo).



Another change in MLCad is related to the MLCad.grp file. This file contains the structure for the parts tree you can see in the top left pane of MLCad. The file has been changed to make things easier for those just starting out with MLCad, but for users who already have some experience it may pose a minor obstacle: if you have added custom groups to the parts tree – as explained in part three of this tutorial – installing the latest version will overwrite MLCad.grp and so eliminate any changes you may have made. In order to avoid this there are two options. You can either not copy the new MLCad.grp file into your installation or you can open the file and copy your modifications over into the file (e.g. using notepad) before copying it..

To finish off a few words about installing MLCad v3.30 (you can download it from the official MLCad website [5]). The program doesn't require any installation. All you need to do is decompress the zip file that contains the latest version and place it in the directory of your choice..The first time you launch the program it may ask you if you want to register the files that are associated with it to which you can answer yes. Any further configuration is done with MLCd.ini. This is explained in parts 4 and 5 of this tutorial. It is advisable to always use the latest version of MLCad.ini and make sure that it is properly configured to find the library of LDraw parts you have installed (By default MLCad.ini expects to find the library under C:\LDraw)

- [1] <http://spurn.lm-software.com>
- [2] <http://news.lugnet.com/cad/?n=16368>
- [3] <http://www.ldraw.org/Article550.html>
- [4] <http://www.ldraw.org/Article93.html>
- [5] <http://www.lm-software.com/mlcad/>



# An introduction to Robotics with LEGO® MINDSTORMS (IV)

## How does a robot feel?

*Text and images by Koldo*

The title of this article is a small little joke, although one of the characteristics of a robot is its capacity for collecting information from its surroundings, something that's intimately related with feeling. It is something robots still do quite clumsily, but which is being improved little by little thanks to the sensors they use.

But simply collecting information isn't enough; it needs to be processed and decisions must be taken based on the information. This is something living creatures do instinctively. In the case of robots their programming carries out this task.

### Sensors

Sensors are devices capable of converting the value of a magnitude (of something that can be measured) into an electrical signal which can then be transformed into numerical data.

LEGO® MINDSTORMS and the NXT-G software offer a system with which you don't need to worry about how this works in such a way that the use of more or less sophisticated sensors is available to every type of user.

Version 1.0 of the LEGO MINDSTORMS NXT set contained 4 sensors: sound, light, ultrasound (to measure distance) and touch. In version 2.0 some changes have been made and it contains the following: a colour sensor which can also be used as a light sensor, two touch sensors and an ultrasound sensor. Soon it will be possible to buy the colour sensor separately.

But this is not the end of the available sensor options for a LEGO MINDSTORMS robot; with the NXT, LEGO opened up the market so other companies could offer complements to its system. As a result, at this moment there is a considerable number of available sensors for the NXT.

In this article I will present some of the options that are available to anyone who want to extend the sensor system of their robots.

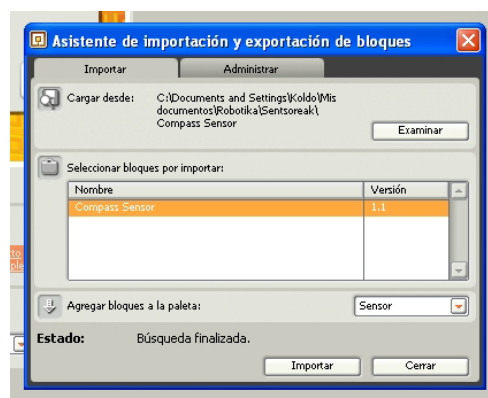
### Manufacturers

The largest part of available options is made by two companies: Hitechnic and Mindsensors. The first of these offers LEGO certified sensors with an external appearance that is similar to the original ones, while the second has an interesting assortment aimed at more advanced users. Both offer the necessary software to be able to use the sensors with the NXT (NXT-G programming blocks and drivers for other languages).  
The software

In order to use a new sensor with NXT-G you need to have the corresponding programming block. This block can be

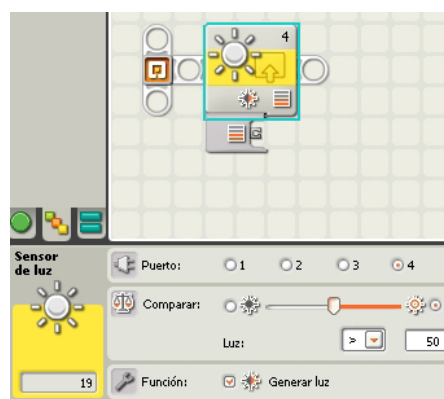
downloaded from the official website or the manufacturer and needs to be installed into NXT-G. After downloading the block we need to follow the following steps:

1. Open NXT-G
2. Open Tools > Block Import and Export Wizard
3. Use Browse to go to the folder you downloaded and extracted the block to
4. Select what palette e want the block to appear in (in our case Sensor)
5. Click on the name of the sensor and then on the Import button



From now on we will be able to use the block just like any other. An interesting strategy to follow before buying a new sensor is downloading the block and installing it to see what options it gives you.

If during programming we need to know what value a sensor will give in a specific situation - level of brightness, readings from an accelerometer - we can use the option View on the NXT itself or connect the NXT to the computer and use NXT-G create a new program with the block for this sensor. To the left of the configuration panel of this block we will see the value of the sensor as can be seen in the image.



## Accelerometer

In physics, acceleration is a magnitude that represents the change in speed of an object. It's what we perceive when we are on a bus that starts to drive or stops and it is what gives us the feeling our stomach will come out of our mouth when we go on a roller coaster ride. So when something starts moving, when it changes direction or when it stops there is acceleration.

In order to measure acceleration you can use an accelerometer, a device that is ever more present in a variety of applications: Wii controls, mobile phones with rotating screens... They are capable of detecting vertical direction, more or less sudden movements, and transform the signal to generate different behaviours.

The accelerometers available for the NXT measure the acceleration they are subjected to in any direction in space, that is to say in three axis, x, y and z.

We can use an acceleration sensor in different ways but I will mention two uses in this article.



### Detecting and measuring a slope

If we keep an accelerometer that measures three axis still in a horizontal plane, the readings it gives for two of the three axis will be 0 while the value that corresponds to the acceleration of gravity will be  $g=9,8/s^2$ . These values will not change as long as the sensor doesn't move. If we tilt the sensor, at least one of the values will start to increase while the value that corresponds to the acceleration of gravity will go down. In this way the robot is able to detect whether it is on a level plane or on a slope.

### Building a Wii-like remote

Building a Wii-like remote to control a vehicle is an interesting project. This can be done using two NXTs and establishing a bluetooth communication between them or building a vehicle with PF motors and controlling it by means of an IR signal.

Whatever the case, we need to define a way to transmit our commands to the remote control. Traditionally this has been done in remote controlled vehicles and videogames by means of levers and buttons, but the appearance of the Wii-remote has changed our expectations of what a remote control can do: it should be able to detect and measure the movements of a hand and convert these readings into commands.

In order to build such a remote control the only thing we need is a NXT, an accelerometer and a cable to connect both.

## The compass

The compass is a sensor that helps with navigation, as it allows the robot to know which way it is facing. This sensor uses the magnetic field of the Earth to determine its heading.

This can cause some problems in the use of the sensor as both metal masses and motors can affect these readings. To avoid problems it is best to place the sensor as far away from the motors as possible, preferably in an elevated position.

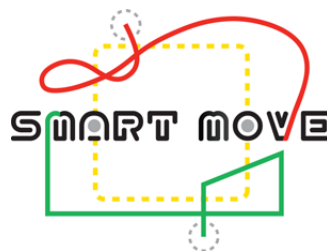
A classical project for this sensor is to build a robot that can turn itself and place it on a rotating surface, or turntable. When the surface is turned the robot will turn itself to maintain its original position.

## Sensors for education

One of the fields where LEGO® MINDSTORMS is used is different areas of education. Among these is the scientific area for which LEGO can be an excellent tool for systematic data collection in various experiments. This data can then be analysed using the NXT-G Education software, thanks to its system of data registering and processing.

Currently there are two companies that provide technology for data collection and analysis: Vernier and DCP Microdevelopments. These companies provide an adapter which allows the use of their sensors with the NXT. Some of the magnitudes that can be measured with them are the following: force, difference in potential, gas pressure, pH, conductivity...

FINAL NOTE: you can find more complete information and all the links in the Lrobotikas wiki (<http://wiki.lrobotikas.net>) #



You can find everything about the final results of the FLL at Barcelona here:

[http://www.firstLEGOleague.es/index.php?option=com\\_content&view=article&id=84&Itemid=100096](http://www.firstLEGOleague.es/index.php?option=com_content&view=article&id=84&Itemid=100096)



**Lrobotikas.net**

Robótica Educativa y Recreativa

# Autochasis 853

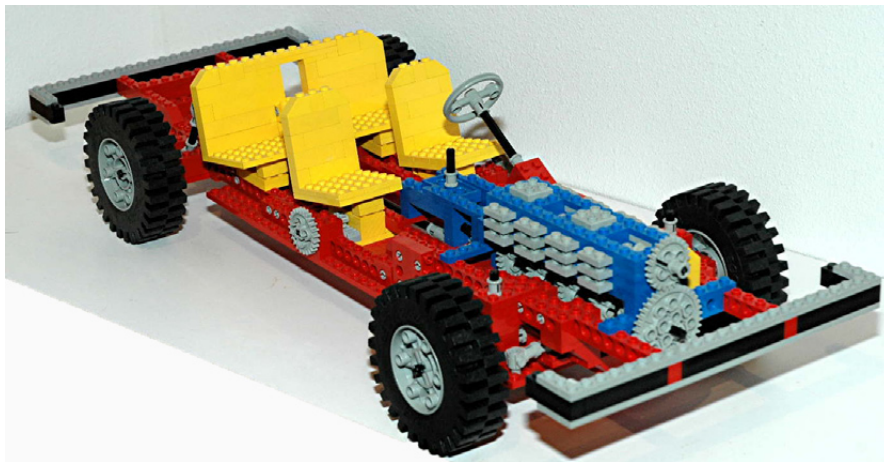
*This new series of articles will show you one of the most famous lines of Technic sets.*

*Text by arvo*

*Images from Blackbird's Technicopedia*

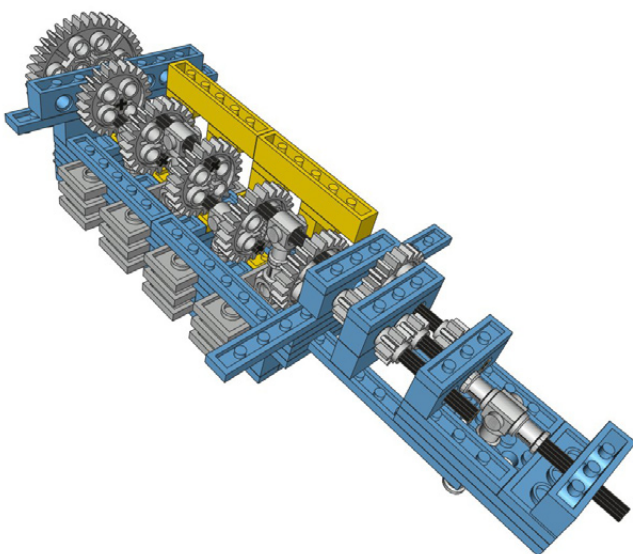
In 1977 one of the most popular and coveted lines began, a collection of sets that lasted for more than thirty years: the "SuperCars." The **SET 853 Auto Chassis** was the first car in this series.

It could seem a rather primitive construction today, but in 1977 it was a revolution whose primary goal was to teach us (playing) the functioning and mechanisms of a car. Designed on a scale that has not been abandoned since then, making it possible to include the most important details.



It had no bodywork, no electric windows, nor a pyrolytic ashtray ... and yet it had everything.

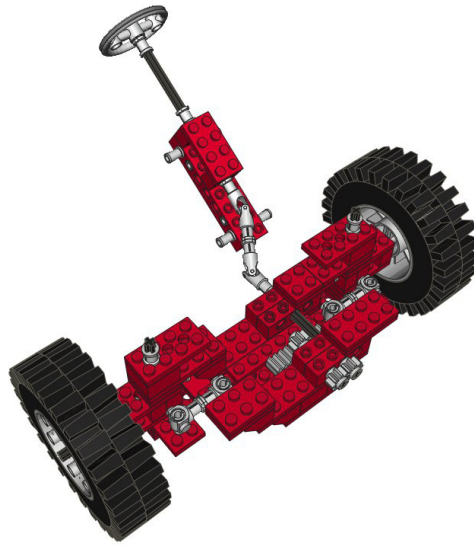
This model had a front engine with four pistons sliding vertically, that "danced" thanks to a transmission that connected them to the rear axle. It must have been fantastic to a 1977 child to have a SET of this calibre. And that's because the "mother company" always had a clear notion of something very simple: the tremendous fascination cars produce in two-legged humans.



The number of gears, shafts, pins, connectors or technic bricks made it a true heavyweight of the era, probably the king of its "promotion". It must have been difficult to imagine what else was needed to build everything one could wish for. The construction is very sketchy. So simple as to allow the hands of a child to build it, but sufficiently detailed to answer any questions.



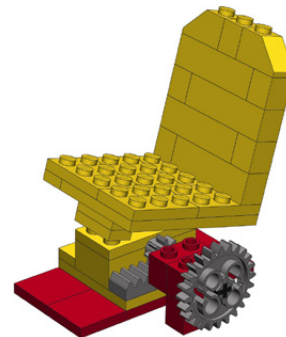
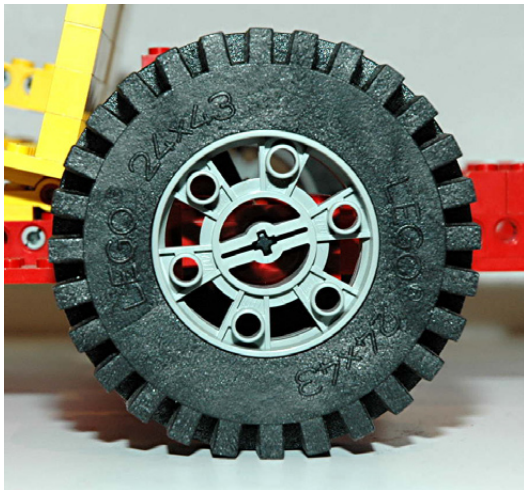
The steering mechanism was one of its strengths. Probably the greatest, after all the steering of the car is the action that manages connect “player and toy”. The rack and pinion steering included some of the most technical parts of the SET. We are not referring only to the “rack plate”, but to the pair of “Technic Universal Joints” that allow you to see and understand how it is possible to transmit rotation on an axle that changes direction. Every bit as fascinating as fragile.



Personally we only find a downside to the system. The excessive length of the steering wheel axle. It is more than a “cosmetic” problem, without going into details ... the wheel, shaft and connectors suffer more than an AFOL would be willing to support without dropping, at least, one tear of pain.

Although ... with that pair! ... “Who could even look at axes, joins, pins or studs???”

The “Technic Wheels 43x24”, which LEGO® released for this set, are as mythical as the design itself. It’s something that has occurred over time; certain parts mark an era and, today, it is almost impossible to think of these wheels and not imagine a child playing on the floor ... a shirt with pointy collar and a round haircut!



But the surprises that were in store in this model did not end here. The seats in a perfectly chosen colour, could be regulated, advancing or inclining them to the liking of the consumer.

This skinny “Automobile”, cold, distant and even austere, was well compensated with a colour palette so “cool” that it made you think as you left the shop:

- “Dude ... that was the purchase of the century!”

Red, blue and... yellow ... Kieslowski could have done better. How many times have we cursed and despised the child in the picture? Very few lucky ones enjoyed this monster in its day, live, in first person.

... it’s what was lacking in our collection of “virtues,” to envy a child on a cardboard box! ... It fits us.

Ah !!!...we would not know the differential and suspension until 3 years later, with its evolution, the 8860 Auto Chassis set.

Thanks to Eric Albrecht for the artwork.

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# Hispabrick 2009: an indispensable event

*For the first time, Madrid was the venue of the third edition of Hispabrick, the annual meeting of the adult LEGO fans in Spain. Once again, the success in number of visitors and exhibited creations was proof that this hobby is on the rise.*

*Text by Antonio José Fernández*

*Images by Antonio José Fernández and car\_mp*

From December 5 to 7, the third edition of Hispabrick took place at the Isla Azul shopping centre. The event has reached a mature youth as a meeting place for adult (and younger) fans of LEGO® constructions. It was marked by the challenge presented by fans in Madrid of preparing and successfully organizing an event of this level of complexity, after two years of organising the event in Castelldefels.

The final result, with its mistakes and failures, was a success in terms of spectators, which forced many of the more than 50 exhibitors to stand by their creations, explaining, showing and, of course, making sure the fingers of intrigued children shouldn't get too close to the bricks. The exhibition, which was divided into three areas, was completed with various activities for the public and some exclusively for exhibitors. The models on display again demonstrate the endless possibilities for building with LEGO, from smaller vehicles to larger dioramas.

The City area, the largest and most populated, was developed around a group of tables arranged in an L. At one end, there was a spectacular country diorama, by Stanspoet and Bitxa, including an amazing scene starring a flying saucer abducting a cow. Separated by the railroad track circuit, the amusement park by Jero, which each year rises on the scale of perfection, and the diorama by Manticore: a remix of monorail, airport and construction works which merited closer proximity to the public.

The long freight or passenger trains brought by Otum and Manti were more visible. They made good use of the track layout to show trains with up to four locomotives and thirty wagons, demonstrating the power and how much you can do with the tracks and engines of 9V. The passage under the city and the area closest to the audience did not go unnoticed by anyone.



In the centre, the building skills of Valgarise, Isabel and Legofan1974 were tested with an elevated city to allow passage of trains and let commuting minifigs take the Metro. Valgarise transformed the rear of all the buildings facing the audience in a delightful set of vignettes as much fun as witty. Isabel brought a suitcase -and this is not a metaphor- filled with a city block with facades and constructive solutions of great beauty and originality. The city was full of details – vehicles, signs, etc – by several builders and ended in two landmark buildings of excellent workmanship, a monumental theatre by Manatarms and an astronomical observatory by El Señor del Ladrillo.

At the long end of the L, the earth ended in a big construction by Car\_mp, including cliffs, a lighthouse and a beach on which the police made every effort to give chase to some nudist – there were children at the event after all. Meanwhile, below sea level, submarine creations by JM left a trail of yellow at the bottom of the sea. This area was completed by the always





amazing dioramas of Legotron, in which The Force is felt in every brick.

This area dedicated to Star Wars™ was completed with several models and dioramas by Lokosuperfluolegoman, who was very active, Vrykolakas showing the Indy adventures in Egypt; Manatarms also exhibited his large-scale minifigs and the HispaLUG forum logo, there was a spectacular sea battle by Gobernador...





The second area was the one that concentrated the largest amount of public with a number of frankly impressive Technic models. The GBC modules, including two railway tracks caused a lot of surprise although the complexity of their settings sometimes caused some problems. Small LEGO® balls went from one extreme to another, jumping, rolling down ramps, raised by screws and belts, transported by railway wagons or fired upwards in a great work of coordination.

Jethro, Sheepo, Blastem and Ignacio were responsible at all times for adjust the delicate machinery of the GBC, whose construction solutions are worth reviewing in the many videos uploaded to YouTube. This Technic area had an interesting show of non-commercial models, foremost among them a fully motorized and remote controlled super convertible, made by Sheepo, that only needed to be a little bigger to be able to actually drive it. We cannot forget the MINDSTORMS® stand



The third of the islands that made up the exhibition was presided by the extraordinary creations of the arvo brothers, capable of using any brick to reproduce reality in ways that no one else can. Besides them, in a line as attractive as difficult to implement, Evo displayed his extensive collection of steampunk models, his great specialty, accompanied by Gorilawer's creations, in which robots and apocalyptic scenes drew a lot of attention.

But there is more: medieval dioramas by SeñorLego, military vehicles of World War II, Bionicle and Harry Potter MOCs., monumental figures of Bender the robot from the animated series Futurama, Mechas, StemPunk ... Work and more work of many enthusiastic creators.

During the two days, there were countless anecdotes and explanations, children blackmailing their parents, the stress of the exhibitors and some angry words on account of the problems and difficulties that arose as a result of the location for the Hispabrick.







Aside from the exhibition, the activities for fans and guests began on December 5 with a social dinner that was a lot of fun, beginning with the correct identification of the participants by our Ambassador Lluís and then with an auction – better than at Sotheby's – in which even bids by phone were made at breakneck speed. A team building contest and an individual building contest – using only the left hand – closed the evening.

During the exhibition, there was time for conferences and the usual pick-a-brick, which, frankly, often bring out a certain level of greed on our part, due primarily to our love of bricks. To sum up, an annual event that aside from the difficulties and different criteria, is also an appointment with the imagination and creativity, whether you are a spectator or long-suffering companion.

I cannot end this article without thanking the management of Isla Azul for the trouble they went through to have us and, of course, the greatest appreciation for the exhibitors who came from all over the country to enjoy an event that every year is again 'the best ever'.

More about the HispaBrick event at <http://www.hispabrick.com>

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# LEGOLAND Billund

## *An essential visit*

*Text and images by lluisgib*

Billund is a town of about 6000 inhabitants in the province of Jutland, the mainland of Denmark. Though you could say that it is in the midst of “nothing”, it has the second largest airport in Denmark. The airport was built by a toy company that has a factory in that town and that 41 years ago built a park focused on the famous brick that this company manufactures. Both the company and the park are world famous. They are The LEGO® Company and LEGOLAND Billund.

At the entrance of the park we can already see that everything we will find inside is made with LEGO bricks, or it will remind us of them. The entrance arch is made of giant bricks and around it, there are many characters made with bricks that perform different tasks such as mowing the lawn or interview other minifigs that “come” to visit the park.

Once you clear the entrance, like in all theme parks, you will find the first stores (clothes, food and many bricks). As the park opens at 10, but the site does at 9:30, you have half an hour you can dedicate to selecting what you will buy later.

The park is divided into different themes: Miniland, LEGOREDO® Town, Pirate Land, KNIGHTS 'KINGDOM™, Adventure Land, Imagination Zone, DUPLO® Land and LEGO® City. Each of these sections has different attractions for children where they can have fun with water games or theatre. The brick is present in all attractions in one form or another. From 1:1 scale figures made of bricks or moving models such as boats, cars or trains that are made with simulations of giant LEGO pieces. We can highlight two attractions that are a bit more for adults, Cinema 4D (3 Dimensions plus special effects), and ATLANTIS SEALIFE, an aquarium with all kinds



of marine species mixed with LEGO models within the pools.

Although the park has its interest as a funfair, for the AFOLS the most interesting part is Miniland. It is a set of dioramas, at 1:20 scale, which represent different parts of Europe, with breathtaking views of buildings and lifestyle of each of these regions. I will not make a detailed description of each, as it would take a whole book, but I will give a brief description of some of them so you may have an idea of what can be found there.

Billund Airport is reproduced and has planes that move along the track and to the fingers, which are then coupled to the aircraft. The planes are very well reproduced and are from different airlines. Note that there is a reproduction of an Airbus







networks of each country) and ships that sail to harbours or channels.

In every diorama there are many small details, some very concrete, that give added value to buildings, and others ones that draw a smile from the children (and the older ones as well).

Miniland is designed to spend hours watching. In my two trips to LEGOLAND Billund, I took about 2000 photos, but I could not capture every detail as it is impossible. There are hundreds of them in each model. If you want to visit the park with children, it is worth spending a day at the attractions and the other at Miniland, because without realizing it, you can easily pass 4 or 5 hours looking at every single detail.

A380 (the largest aircraft in the world) of Singapore Airlines (if I remember correctly, the first company to receive one of these planes) and a reproduction of the retired Concorde, the fastest passenger plane of the world, from British Airways.

Ribe is the oldest town of Denmark, and was for many years, the city where the kings resided in this country. It is about 60km from Billund. LEGOLAND paid tribute to this town, with a reproduction of the streets. It still retains some medieval touch in its design and configuration. During the trip, I made a stop to visit this city and I can say that the reproduction is amazing.



At the end of the visit, I find myself in one of the shops, the famous dream of every fan: buying parts by weight. Although the selection is not great and the price is a bit high, I could not resist filling a bag with parts and accessories for future MOCS. Also, I bought some gadgets from the park to remember the visit and to redeem some sins ... (right Delia?). This is what happens when you go to certain places on your own. Not everyone understands it the same way .... although they accept it with a bit of resignation.

#

Another wonderful view is Nyhavn, Copenhagen harbour. All the buildings, bridges and statues of this famous corner of the Danish capital are faithfully reproduced. Among the reproductions of the Danish capital, we also can find the Amalie Gardens or the Fire station of Copenhagen.

Leaving reproductions of items or Danish cities, you may find locations of Germany, Japan, Sweden and Scotland, among many others. There are also more specific models such as the NASA space shuttle, or moving models like a system of locks through which boats go up and down, or trains that complement many dioramas (trains reproducing the various national rail





# AFOL Weekend - Skaerbaek

*Text and images by Illuisgib*

You know that I usually start my articles on events with an introduction about my journey from Barcelona to the destination. In this case, I can not give that information because I had to get up at 2:15 in the morning and I am not fully aware of everything that happened from that moment until my arrival at Billund Airport ...

There I met Maja, a Danish AFOL from the Byggepladen LUG, who led me to the town of Skærbæk, about 60 km from the airport. During this journey, Maja gave me a brief introduction about the event and we also talked about our respective LEGO® preferences. We arrived about 10:30 am at the Fritidscenter complex, a resort with 50 bungalows and many sporting venues. Among them there were two indoor sports centres the size of a basketball court, where the event was held.

On arrival, I met one of the organizers of the event, Peter Vingborg. He is a very organized man and he had prepared my arrival. He showed me the place where I had to put my little MOC, "the Castellars" that were present at the first Hispabrick (which is easily transportable in hand luggage). He also gave me my badge and some small souvenirs of the event. Apart from that, I could see a model they were building at that time. It was the creator house 4954 - Model Town House at 6:1 scale! The model has over 100,000 parts and was designed for the



DK LEGOWorld event held in February 2009 at Copenhagen. They had the help of The LEGO Group to obtain the parts and the result was spectacular, especially when you compare it to the original model. The house was mounted as if it was the original model, since the bricks were all built all at 6:1 scale.

Then I met another one of the organizers, Caspar Benders, with whom I chatted animatedly about many subjects, and also Svend Erik Saksun, the Danish LEGO Ambassador. I had been in contact with both of them by email, but I did not know them in person. During the afternoon, many AFOLs came and filled up the tables with their models and displays. While all these models took shape, some workers were assembling LEGO product shelves in a corner of one of the pavilions. It was an Official Store, which offered the large majority of sets of the catalogue and also some offers and discontinued models, for example the Castle Chess (the largest one) or the Market Street, which were selling the last units in stock. There were some boxes with spare parts and bagged parts, which were gone in no time...

The models on display were spectacular. Like most events I'm visiting, CITY displays predominate, and apart of one collaborative display of 30 square meters, there were several more individual displays. A fully functional amusement park and the home of "Uncle Scrooge" but with the symbol for Euro





instead of symbol of the dollar were the constructions that impressed me most. I must also highlight a huge collection of Technic tractors, which were copies of existing models in Denmark, each of the tractors with the photo of the original model. I have to admit that they were virtually identical. Among these models, there was also a replica of the train that goes around the park LEGOLAND: a fantastic reproduction. As an example of something that struck me, there was a MOC (it was about 1.5 x 1.5 m) which reflected the 4 seasons in 4 semicircles with a lot of detail.



On Saturday, Lisbeth Valtho Pallesen, Executive Vice President, Division of Community, Education and Direct, was present at the inauguration. She was commissioned to make a short speech and cut the ribbon. From that moment, it was all about talking to everyone about the MOCS that were present and possible new models for the coming years. If the decisions were in our hands ...

In the afternoon there was a big surprise at the event. We were visited by Kjeld Kirk Kristiansen, present owner of The LEGO® Company. He spent over two hours watching what was exhibited there, talking and taking photographs with all the fans. I had the pleasure and honour to have a word with him.



We talked a bit about my MOC and about the history of



Castellers. At all times he seemed very friendly and interested. After the brief conversation we took a photo. It was one of the most special moments of my life as AFOL.

At 5 the show closed to the general public, but remained open to the AFOLs. We had a couple of hours to relax, to chat and walk throughout the event, without having to keep an eye on our models.

In the evening there was the official dinner, with contests and auctions. It was evident that we were in Denmark, since many of the things auctioned were real collector jewels.

The next day, before the event opened to the public, I took pictures of all the models, and made my last purchases before meeting again with Maja, who took me back to the airport in Billund.

Like with all events, one leaves very happy and with a bit of sadness. In this case, due to the events that I experienced there, I won't easily forget many of the moments I spent there. As always, I hope I will return to this event. I will wait with impatience.

#







## Review 8970: Robo attack

*There cannot be a 007 issue without secret agents*

*Text and images by Gorilawer*

There always has been a struggle between good and evil, and this is what the recent Agents line focuses on. A group of agents of some type of organization try to stop the evil plans of dangerous gangsters, using all sorts of new technologies incorporated in impressive vehicles. There have been many lines with this topic as a basis. Today we can find the same idea lines like Space Police III or Atlantis.

The new Agents 2.0 sets are quite amazing. Among the new sets we can find the 8970, a giant robot which confronts the Special Forces while citizens and tourists are looking on, stunned and terrified.

The box says a lot by itself. The sleek lines show the set and its strengths very well, but without revealing all the secrets. On the cover there is a picture of the mechanical monster in action making mischief in a city. A carefully designed image that shows exactly what we will find inside.

On the back we can find all the gadgets of the set and some images of other sets of the same line. Here all the secrets of the set are revealed and in the lower part we find a picture of the minifigs, one of the most important points because there are six in this set, five of which feature two different expressions on their heads. This adds even more to the playability of the set.



On the sides we again can see the images of the minifigs which are the biggest attraction of the set, classified into heroes, citizens and the villain.



As a curiosity, the box opens with a lip and can be reused to save the set or other items, which is useful since it is a heavy-weight cardboard box.

If we check the contents of the box we see that it is only filled for about 40%, which is not very helpful to keep instructions and stickers in good conditions and these are likely to bend. LEGO® could have saved on cardboard, although visual impact would be lost to the audience of the set.

The set consists of 4 bags of mixed parts, divided by instruction booklets, the instructions booklets themselves, stickers and the transparent dome which is not bagged.

Construction is pleasant and not at all repetitive. The first thing we build are the minifigs, as usual, then the jet and the quad of the agents and a small slider of the evil enemy.



Here a picture of the minifigs with the different expressions on their faces.



Next we will build the robot, which is modular; it is made up of parts or segments which are subsequently joined to create the robot. First the main body with the transparent dome, then the legs and finally the arms of the monster. During the construction we find some interesting techniques and details like SNOT and studless in the body and legs of the robot.

The arms are different one from the other. One has a metal claw that can rotate and the other has a flame thrower that lights through a brick with integrated batteries. In fact, to avoid the battery running out before opening the box, the light brick has a small tab that interrupts the circuit and has to be removed to make it work.



The finished set has a very innovative design, with lots of gadgets and curious details. It has parts in silver and dark blue, new parts like the dome, the minifigs... all are strengths for AFOLs who wish to acquire this new set that leaves no one indifferent. We could say, as has become customary in the current sets, that the stickers are an inconvenience, but the set has plenty of printed tiles that balance the scales. In fact, without the stickers, the set does not lose visual interest, as may occur with some racers.

Personally I think the set is quite balanced in price and quality, taking into account the design of vehicles, gadgets of the set, colours and the minifigs it includes, all very striking.



And to finish the review, a small MOC built only with parts of this set. Greetings to all readers and thanks for reading this review.

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## Review 8049: Tractor with Log Loader

### *A good introduction to Pneumatics*

*Text by lluisgib*

*Images by lluisgib and LEGO® Systems A/S*

Set: Tractor with Log Loader  
Set number: 8049  
Part count: 525  
Includes: Tractor, Trailer with pneumatic functions, a log.

#### **Introduction**

It's a bit strange for an AFOL like me – being a City fan – to do a review of a Technic set. It's not that I don't like Technic; I have a couple of sets from this line, like the Bulldozer, but it's not a line I follow as a rule and I had never before built any set with Pneumatics. To me that is an interesting world and I believe this review will have a slightly different angle, since I will be looking at the set through the eyes of someone who discovers Pneumatics in Technic.

As its name already indicates, the set consists of a tractor with

trailer for carrying logs. The tractor itself isn't very hard to build nor does it have any special characteristics apart from the fact that, like most Technic sets, it has steering (front) wheels. The only thing that stands out is the stylised design due to the use of Lime Technic, Liftarm 1 x 11.5 Double Bent Thick for the front and Lime Slope, Curved 2 x 4 x 2/3 No Studs for the rear mudguards. The steering can be accessed from a Round Brick 2x2 behind the cab and which also serves as a signaling light.

#### **Construction**

The trailer is where all the functional design of the set is located. It has an arm with three segments and a claw at the end, designed to pick up logs and load them on the trailer. But let's take it one step at a time.

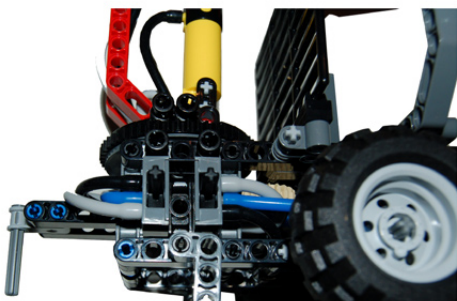
The first thing you build is the chassis of the trailer and right at the start the first Pneumatics element is incorporated: the





pump. It is placed on the rear of the trailer so you can operate it once the model is finished. The rod is surrounded by a spring to make the cylinder work as a pump. After this, an axle is introduced which traverse the whole trailer in order to allow manual operation of the turning of the arm. Next up is the block that holds the switches for the air. At this point you start appreciating how the whole system works. Two switches are used, one for each cylinder. Each switch has three ports

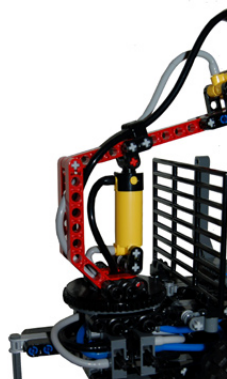
cylinders. The first segment of the arm starts at this turntable which is fixed to the chassis. Four liftarms make up the second segment of the arm and the cylinder is placed between the first and second segment. Then the tubes are connected to the cylinder; the gray one to the bottom port, to make it expand, and the black one to the top port, to make it contract. At this point curiosity takes over and makes me test the functioning of the cylinder before finishing the rest of the construction. I pressurize the circuit and push the lever on the switch upwards. Automatically the cylinder expands, and with it the arm. After this test I continue with the third segment and the second cylinder.



The third segment is made up of 3 liftarms. I attach it to the arm with a long pin and place the other cylinder. This cylinder is connected to the second segment and the rod is fixed to the end of the third segment. I connect the tubes and the Pneumatics circuit is complete.

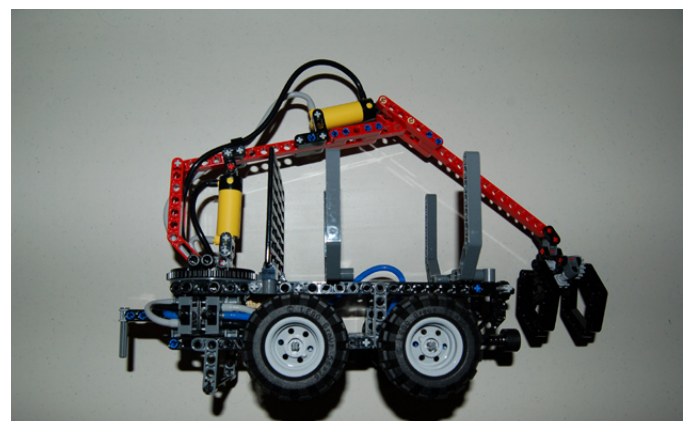
Finally, I attach the claw and build the trunk and the set is finished.

through which air can circulate: one inlet (the central port) and two outlets. I connect the manual pump to the two inlets using a T piece. I also connect the tubes to the outlets which will later be connected to the cylinders. In order to avoid confusion with the connections, the tubes that will make the cylinders expand are grey and the ones that will make the cylinders contract are black.



The construction continues by connecting the parts that will allow the arm to turn and the tubes are pulled through its centre to guide them towards the

It is interesting to do some tests with the Pneumatics system. I have fun watching the cylinders expand and contract and look for different combinations to make the arm go where I want it.





There is only one fault: Each time I want to make a movement I need to pump air into the circuit.

The guys over at LEGO® Technic have thought about this as well and have found a way to solve this problem. To implement the solution the set has a number of extra parts including a small cylinder to which you need to add a Power Functions battery box, a Power Functions M motor and a 24 tooth gear with clutch. All of these parts can be found in the 8293 set (Power Functions motorization set)

The instruction booklet gives step by step instructions on how to implement this conversion. You need to take out the large cylinder that acts like as a pump and substitute it for a smaller one that is connected to the motor and the clutch. You also need to make some small changes to add the battery box.

After making these changes I realize the air circuit is permanently pressurized. Even when the pressure level is high, making it harder to operate the small cylinder, the circuit is not overloaded due to the clutch gear and the motor can be left on all the time.

On the official website there are instruction for an alternative model which allows you to explore the world of Pneumatics a little further.

## Conclusions

This set is very recommendable for someone who, like me, wants a first introduction to Pneumatics. The building steps and colour coding of the parts make the construction and the comprehension of the pneumatic circuit easy. Operating the model is fun and didactic. In my opinion is has been a good decision to add the necessary parts and instructions to pressurize the system constantly with Power Functions elements. Likewise, the fact that LEGO has published additional building instructions on their website gives extra value to the set and motivates anyone who buys the set to experiment with new solutions.

On the other hand, for builders who are used to Technic and Pneumatics, maybe the set is a little simple, but for the price of the set they get a good assortment of Technic and Pneumatics parts.

Thanks to: LEGO Systems A/S, TECHNIC design department for providing the set. LEGO Iberia S.A, Joachim Schwidtal, Rosa Seegelken and Alejandro Cano for the official images.  
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## Review 10211: Grand Emporium

*Let's go shopping!*

*Text by lluisgib*

*Images by lluisgib and LEGO® Systems A/S*

Set: Grand Emporium.  
 Set number: 10211  
 Part count 2182  
 Includes: 7 minifigs, changing room, escalator, chandelier,  
 billboard, many complements.  
 Recommended Price in Spain: 149,95€

### Introduction

Normally when I build a set and then make a review, I have already seen pictures on the internet with lots of details or important elements. This time it has been very different and exciting. I got the set about three weeks before its official presentation. Very few images of it had been seen and I didn't know many of its details. I have enjoyed building and discovering its many details a lot.

I believe it is worth starting with the box, as LEGO® have done a great job on this aspect of the set. The box contains numerous images that show many of the characteristics of the set. On the front, as always, you can see the finished building. On the top, the inventory. On one of the sides there is a curious image of the interior, showing a section of all three floors. On the back, many of its secrets are revealed. You can see the interior of the three floors, many scenes of the interior of the building, some of the constructions that decorate the inside

and a composition of the Emporium, the Fire Brigade and the Green Grocer. It's one of those boxes that's worth keeping.

### Construction

As always, I start building the minifigs. In this case there are six, and a seventh that will be built together with the top floor. The set includes a female shop assistant, a customer, a child and two mannequins.

These last two are normal minifigs but with the head turned backwards so there is no expression on their faces. At first I thought they were faces without silk-print, but that would add another reference to the inventory with everything that implies. As in all these sets, the minifigs have the classic smiling face. The customer carries two shopping bags by way of accessories.

After building the minifigs I start with the ground





floor. Since this is a corner building there is more pavement. In front of the door of the store, there is a blue, White and light grey mosaic which, together with a couple of flowerpots, invites passers-by to enter and buy. The rear of the pavement is dark grey with a few touches in front of the shop windows. As always, there are a few manhole covers, a lamppost and a mailbox, in this case the typical Danish mailbox you can find in the city sets of the last couple of years. As an extra, there is also a small ice-cream stall which makes the ensemble of the pavement very complete.

The construction of the building isn't one of the most elaborate ones among the modular buildings. Basically, the wall goes straight up from the ground floor to the first floor. There are a couple of complements that are worth pointing out, like the dark green awnings, made up of two slopes curved 3x3x2 which are new this year. The result is beautiful and breaks the monotony of the colour of the main façade. At the entrance of the building there is a revolving door. From the outside it is really striking, but on the inside it takes up too much space, which prevents you from placing more counters with products for sale. Above the revolving door the name of the warehouse is built with plates, in this case using the generic term "SHOP". It is very interesting to see how the curve has been achieved. Using a Hose as support and by means of Plates with Clip connected to the letters these are fixed to the hose to get the desired curvature. To finish off the corners and the sides of the entrance, there are a couple of columns with lamps that lend a certain elegance to the building

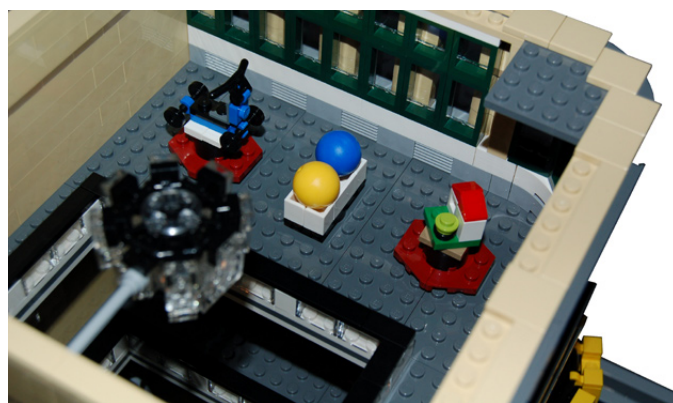


The interior is quite complete. There are two sets of shelving on the wall for trousers for children. A table with perfumes. A fitting room where the minifigs can try on the most fashionable designs. The method used for making the curtains of the fitting rooms is quite curious. They are made with two Darth Vader capes which turn out to be most effective for this purpose. In the shop windows there are two mannequins on one side and two hats on the other. On the backside there is a door that gives access to the rear of the building. Finally, in the centre of the ground floor there is a table with a cash register and below it some jewellery, conveniently protected by a safe showcase so no one can steal the products it contains. When the first images of the Grand Emporium appeared, many were fascinated by the incorporation of escalators. They are one of the most outstanding details of this set. They consist of a Plate 4x10 and a Plate 4x4, to which Cheese Slopes 1 x 2 and Tiles Modified 1 x 2 Grill are connected alternatively. On the sides bricks and above those Hoses for the railing of the escalator. With some Brick, Modified 2 x 1 x 1 1/3 with Curved Top the entrance to the escalator is made. The only detail that has not been well finished is the connection at the top. In

principle the escalator leans against the wall of the next floor, and the cheese slope should be perfectly level with it so that, by means of a decorated Plate 2x2 placed on top of the studs of the wall and the Cheese Slope 1 x 2 it should be perfectly connected. The result is slightly different because the Cheese Slope 1 x 2 is slightly above the required level, and the Plate 2x2 isn't well fixed to the stud and with the inevitable vibrations during construction it ends up coming loose. This doesn't take away the fact that the escalators are one of the strong points of this set.



The first and second floor have basically the same design, with the small modifications caused by the fact that the first floor has an escalator to go to the next floor and the second doesn't. The exterior design is based on a couple of columns which end in arcs and behind those big windows which allow for great luminosity and visual access to the interior. On the corner the façade is finished with a Fence Spindled 4 x 4 x 2 Quarter Round with Windows on the back side, placed on top of a White Brick, Round Corner 4 x 4 Macaroni Wide with 3 Studs. On the first floor there are some blue and red flags which contrast nicely with the colour of the façade. The interior consists of two counters with household items (wine glasses and plates). The barrier around the gap for the escalator is made with transparent bricks, which transmits the feeling of a glass wall. At the top of the escalator there is a window which gives it a bit more light. The window has been placed here because it doesn't interfere with the walls of the adjacent buildings and because the door that gives access to the rear is right below it.



On the second floor there is a toys department with some balls, a little house and a skateboard. But what is most striking is the finishing of the stairwell which is a big chandelier. Although it is simple it is very beautiful and you immediately want to incorporate some kind of LED to be able to switch it on and let it do its job. It is fixed to the wall with an antenna, which means it doesn't hang from the ceiling and you can see it when you remove the roof. Apart from that this floor is practically identical to the one below.

On the roof there are several elements that are worth





mentioning. On the one hand there is big skylight right above the stairwell and the chandelier. In order to build it the 12 stud windscreen of the Model Team line has been reused. With two of these a pyramidal skylight is made and the inside can be seen very well.

To make the cornice, the designers have used a new element which is very useful for this kind of cornice or as a support for balconies. On the corner, a flower provides a touch of distinction. On the other side of the roof a big billboard crowns the roof, with the logo of the shop. This logo has been divided into two parts. One of them is a reproduction in tiles of the head of a minifig. The other part is a gift box in relief. Three floodlights illuminate the billboard making it virtually identical to a real billboard.

To finish off construction, a building with many windows need a window cleaner. In this case we don't get only the window cleaner, but also a platform that is suspended from the cornice to allow the window cleaner to do his job. It is the final touch that measures up to the rest of the construction.



### The ensemble

What is so nice about these sets, compared to more commercial sets, is that when you finish building them you don't get this empty feeling, that is to say, that what you see on the box appears to be more than what you get. From the beginning of modular buildings we have seen a great chromatic variety, from the Dark red of the Café Corner to the Light Blue of the Market Street and the Dark Green of the Green Grocer. In this case the tan building adds another colour scheme to our street.

In my opinion, the balance between the outside and inside of the building is very good. The outside isn't as elaborate as in other buildings, but the inside is an improvement. On each floor there are details worth mentioning, from the escalators to the chandelier or the billboard on the roof of the building. The variety of products that can be sold in a shop of this type has also been taken into account and has been included: clothes, perfumes, jewellery, household articles, toys... Having 7 minifigs is a luxury and it adds life to the building.

### Conclusions

The building is very elegant. The combination of colours is rather sober, but the result is brilliant. The exterior design isn't spectacular like in other building, but that doesn't mean it isn't beautiful. All the extras on the inside allow you to enjoy the construction from the beginning to the end. From bottles of perfume to toys or jewellery, each step is a discovery of new surprises. At no time does it become tedious even though there are two similar floors. Each one has its small touches that make building pleasant. The minifigs are varied and make the set very playable. The winks to the AFOL community, like the use of the Model Team Windscreens, are very much appreciated. To many those parts will evoke past times (and I suppose good times).

There are few things that can be criticised and they have already been mentioned in the construction process. These small defects go unnoticed when you have the whole building in front of you.

It is going to be very difficult to top this, but my mind is already thinking about how LEGO will surprise us with the next modular building. We will probably have to wait another year to see it, but I'm certain that the designers will surprise us once again.

There is only one thing left to say... Let's go shopping!

Thanks to: LEGO® Systems A/S, TECHNIC design department for providing the set. LEGO® Iberia S.A, Joachim Schwidtal, Rosa Seegelken and Alejandro Cano for the official images.

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## Interview with Jamie Berard

### Senior Designer/Design Lead for LEGO® Direct

By Hispabrick Magazine

Picture by Jamie Berard

In this issue we have the opportunity to interview one of the designers of the new modular building you have just read about. We hope it will clarify all your doubts about the modular building design

**Name:** Jamie Berard

**Age:** 34

**Position:** Senior Designer/Design Lead for LEGO® Direct

**HM:** Was designing a mall on a corner the first idea?

**JB:** We were very open to possibilities with the design of this new building. Because it was going to be a corner, we wanted to explore options which would not be possible in a middle section. Municipal buildings and larger types of buildings were tops on our brainstorming list. The department store offered a perfect opportunity for an expandable layout with some very different and fun detailing, so that's pretty much why we went in that direction.

**HM:** How did you face the challenge of a modular building after the high level of the other ones?

**JB:** It is a fun challenge to always try and better ourselves. I have to admit it's much more difficult now to impress and surprise fans considering how many hundreds/thousands of beautiful modular creations they have made over the past few years.

The best way to keep ahead of the curve is for us to continue to push the boundaries of what our bricks can do. Playful curiosity can create some marvellous results. My desk has a whole host of half-built assemblies which highlight unusual relationships between elements, funky geometric patterns and numerous little odds and ends that were built for other models but which just didn't quite fit in. It's the desk of misfit toys. However, I'm a firm believer that no idea is ever a lost effort. It sometimes just needs the right time to work out.

**HM:** What kind of restrictions were in the design?

**JB:** Like most all LEGO models, we had the usual restrictions of cost and time. We also limited design explorations by very early on deciding that this model would be a corner building to take the place of the Café Corner.

We have some internal guidelines which we established at the onset of the modular building series. The connection points and sidewalks are the first and probably most important constraints. Our minifigures all have the classic smiley face. (Market Street is the only exception because it was developed through LEGO Factory who chose more expressive faces). We intentionally avoid using stickers. If it can be built, we build it. This helps explain the many ways we've explored writing letters and numbers in brick.

We also have a limited number of elements which we can make into other colors or print on. Developing new elements is also not an option for us. We try to leave as much money as possible for the bricks in each set. We want you guys to get a great building experience plus a reasonable value for your money.

**HM:** Where did you take the inspiration to design the building from?

**JB:** The building is mostly inspired by large department stores in New York, Boston and London.

**HM:** How do you decide the internal decoration and which level of detail can you apply?

**JB:** The level of detail for the interior is very much determined by the remaining budget for bricks after the exterior is built. This can probably best be seen in the Green Grocer. The first floor doubled in cost after we added the interior. Had we offered the same level of detailing on the upper floors, the model would have had to go up in price.

We love using rare and unique elements in the modular buildings. However, these bricks tend to be very expensive. We need to think smart about other parts of the buildings in order to help afford strategic 'gems' which we know you guys will love!

The Grand Emporium includes almost double the minifigures of any previous building. It also has old Model Team windshields, strings, transparent elements and built escalators. These all add up, so it's really important for us to be a bit more modest with other parts of the model.

#







## Great creators of the world: Luca Rusconi

*This time we bring you a genius of Formula 1 replicas. The most emblematic models of the history of this motorsport with the highest level of detail*

*By Hispabrick Magazine*

*Images by Luca Rusconi*

**Hispabrick Magazine:** Name?

Luca Rusconi. My nick is RoscoPC

**HM:** Age?

**LR:** 39

**HM:** Nationality?

**LR:** Italian. I live about 30 km from Milan.

**HM:** What do you do normally?

**LR:** Manager of an engineering department.

**HM:** When did you first start building with LEGO®?

**LR:** In the early seventies. I was very young when my parents gave me my first set.

**HM:** Your first set?

**LR:** It was the 355 Town Center Set with Roadways, in 1973. At that time I wasn't able to build it by myself, but I remember

that I had a lot of fun playing with it later on.

**HM:** And your last set?

**LR:** The 10019 UCS Rebel Blockade Runner that I missed before.

**HM:** ¿Your favourite commercial LEGO building theme?

**LR:** Currently I'm collecting mainly Star Wars: I like the overall quality of these sets and the way LEGO is reproducing the characters and vehicles of the real saga. In the past I was more oriented to the Technic theme, but IMHO they are losing playability in the last years, and after the Bulldozer 8275 I'm still waiting for a good set that is worth buying.

**HM:** ¿And your favourite non-official building theme?

**LR:** I should say cars in general, but I don't really have a favourite theme. I like to watch and inspect carefully any MOC that calls my attention regardless if it's a castle, a monument or a crane. I like the genius and talent that many AFOLs put in their creations.

**HM:** What is your favourite LEGO element and why?



Formula 1 cars when I came out of my dark age, first modifying some original LEGO Technic models, then focusing on the details like a modeller trying to work out new and original creations.

The current generation of F1 cars are still interesting but the differences between all the various cars are very subtle. Without paint schemes, it would be difficult to tell them apart. Thus I prefer the strong personality of the old cars that made the history of the Formula 1 and became milestones by introducing reference technical solutions for subsequent years. Those are very popular cars, not only among F1 fans, and can be easily recognized (especially if you are 30 or older!).

**HM:** Where do you get information about the real cars?

**LR:** Since we are talking about Formula 1, it's quite easy to find pictures and

videos on the web, while it's much harder to get your hands on details hidden underneath the bodywork: official information about the chassis dimensions, the shape and geometry of the suspensions, the engine configuration, etc. When available, also the building instructions of static models are useful to gather technical data and clear drawings to proceed with the design.

**HM:** Which is the most difficult part to reproduce in a F1 car with LEGO?

**LR:** Normally the suspensions, but mainly because I want to reproduce their shape and geometry as correctly as possible (and they have to work properly!). I use many Technic parts there, and I like to introduce newest parts as soon as they are available.

**HM:** In your models, do you sacrifice functionality or aesthetics?

**LR:** What I like most are the newest Technic parts that allow me to find more compact and sturdy solutions. Among them, the short Technic Universal Joint (item bb320 on BL): with a 3 stud length instead of 4 as before. I have more freedom both in drive shafts and steering.

**HM:** Which part would you like LEGO® to produce?

**LR:** In the last years some of most desired parts of AFOLs have been really produced by LEGO, but my selfish request would be to produce a shorter shock absorber and a symmetrical version of the Steering arm 3H (item 6571) in order to have the joint ball on both sides.

**HM:** How many hours do you spend building with LEGO?

**LR:** Really few indeed. My MOCs are mostly developed with a virtual CAD model. My children rarely need my assistance while playing and I still have so many sets to build...

**HM:** What do your family/friends think about this hobby?

**LR:** My parents were happy during my childhood, but when I came back to LEGO after the dark age they were quite surprised. My children are obviously interested and happy to play, while my wife is just starting to get directly involved, but was never against my hobby (except for the cost!). Friends and colleagues are often impressed and interested, and some of them are supporting me in different ways.

**HM:** Why did you decide to reproduce historical F1 cars with LEGO Bricks?

**LR:** I like Formula 1 as an expression of the highest technical skills in different areas like mechanics, aerodynamics, electronics, automation, etc. I tried to build





**LR:** When I start with a new project I decide the minimum amount of features that I have to include, and this will remain a must. But then I know that the first impression is often dictated by the aesthetical aspect, so I put a lot of attention on it, doing my best without sacrifice functionality. I cannot produce a nice looking car knowing that the engine has a wrong number of cylinders or the front steering has a wrong configuration!

**HM:** Have you received any contact from anybody of the F1 World? Have you taken any step in this direction?

**LR:** Well, I never tried to contact somebody because I think that the F1 world is too much business oriented: to be honest I'm afraid someone could ask me to pay some royalty!

But about one year ago I got an email directly from Mr. Clive Chapman, the son of the greatest car designer in the 70s Mr. Colin Chapman and Managing Director of the Classic Team Lotus Limited: he congratulated me for my Lotus car models... Incredible. I'm still embarrassed if I think about my trembling fingers when I replied to him. I'm very proud of it, may I?

**HM:** In real life you work in engineering. How does that influence you as an AFOL?

**LR:** My work itself doesn't influence me as an AFOL, except for the amount of spare time. But I have to admit that now my approach to the building experience is totally different from that of my childhood. When I describe how I design my MOCs and the kind of challenge I'm looking for, often they ask me if I have an engineering degree or similar...

**HM:** Do you draw or pre-designs before you start building?



**LR:** Oh, yes: I completely design my MOCs in MLCad before start any building! This is exactly the new approach I was describing before. This way allows me to try so many different solutions even in case I don't have the correct parts I want to test, but I spend less time playing with real bricks in my hands...

In between I usually prepare just a preliminary sample of the front and rear suspensions to check that the virtual design is working well, and then I proceed with the 3D model with the bodywork and aesthetics.

**HM:** How long does take you to get from the idea to the finished model?

**LR:** The scaling and CAD design activities take at least 4 to 5 months. The purchase of missing parts is always ongoing, but shipping of the rarest pieces from overseas takes another month or so. Then I enjoy the real building for few weeks, but I can see the model materializing in front of me easily and flawlessly.



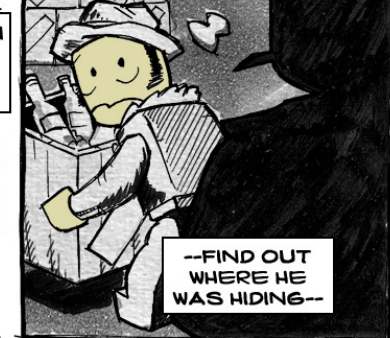
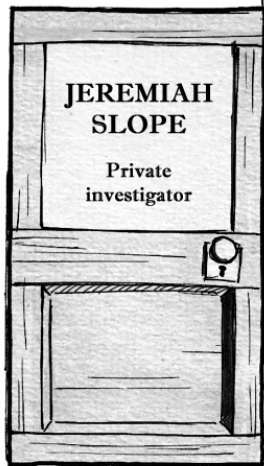
**HM:** The increase of AFOLs and lines like Star Wars create new possibilities not imagined before by LEGO®. What do you think about the old school LEGO and the new LEGO?

**LR:** In my opinion AFOLs are not only players or LEGO clients: they are people looking for a way to express themselves through LEGO products. You can express creativity, art, fantasy, genius and talent with your MOCs, or just passion, love, competence and experience with your collection.

So the old school LEGO was only producing a nice looking and smart toy for young people, while the new LEGO is trying to remove all the limits to our imagination, regardless of our age. We have to tell our children that they have to go further...

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# How to collaborate with us

Collaborating with Hispabrick Magazine is very easy, just send an email with your ideas to [info@hispabrickmagazine.com](mailto:info@hispabrickmagazine.com) and we will help you to "build" your article.

If your language is not Spanish, don't worry, we will find a solution. Contact us now!

#

## Our collaborators on the internet

Amador y Ramón Alfaro (arvo)

Antonio Bellón (Legotron)

Antonio José Fernández (Lordjerome)

Carlos Méndez (Car\_mp)

David Muñoz (Gorilawer)

Fernando Benavides (Sheepo)

Jesús Delgado (Arqu medes)

Jetro de Château (Jetro)

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Koldo Olaskoaga (Koldo)

Lluis Gibert (lluisgib)

Luis (Vrykolakas) y Ana (W3ird)

Paul Ian Kmiec

Ricardo Valero (Valgarise)

<http://www.brickshelf.com/cgi-bin/gallery.cgi?f=127268>

<http://www.abellon.net/lswimperial/>

<http://www.brickshelf.com/cgi-bin/gallery.cgi?m=antonio>

<http://www.flickr.com/photos/carpmp/>

<http://www.flickr.com/photos/36414035@N07/>

<http://www.brickshelf.com/cgi-bin/gallery.cgi?m=Sheepo>

<http://debiologoadibujante.blogspot.com/>

<http://www.brickshelf.com/cgi-bin/gallery.cgi?m=linmix>

<http://www.hellfreak.es>

<http://Lroboticas.net>

<http://www.brickshelf.com/cgi-bin/gallery.cgi?m=lluisgib>

<http://www.flickr.com/photos/23033004@N00/>

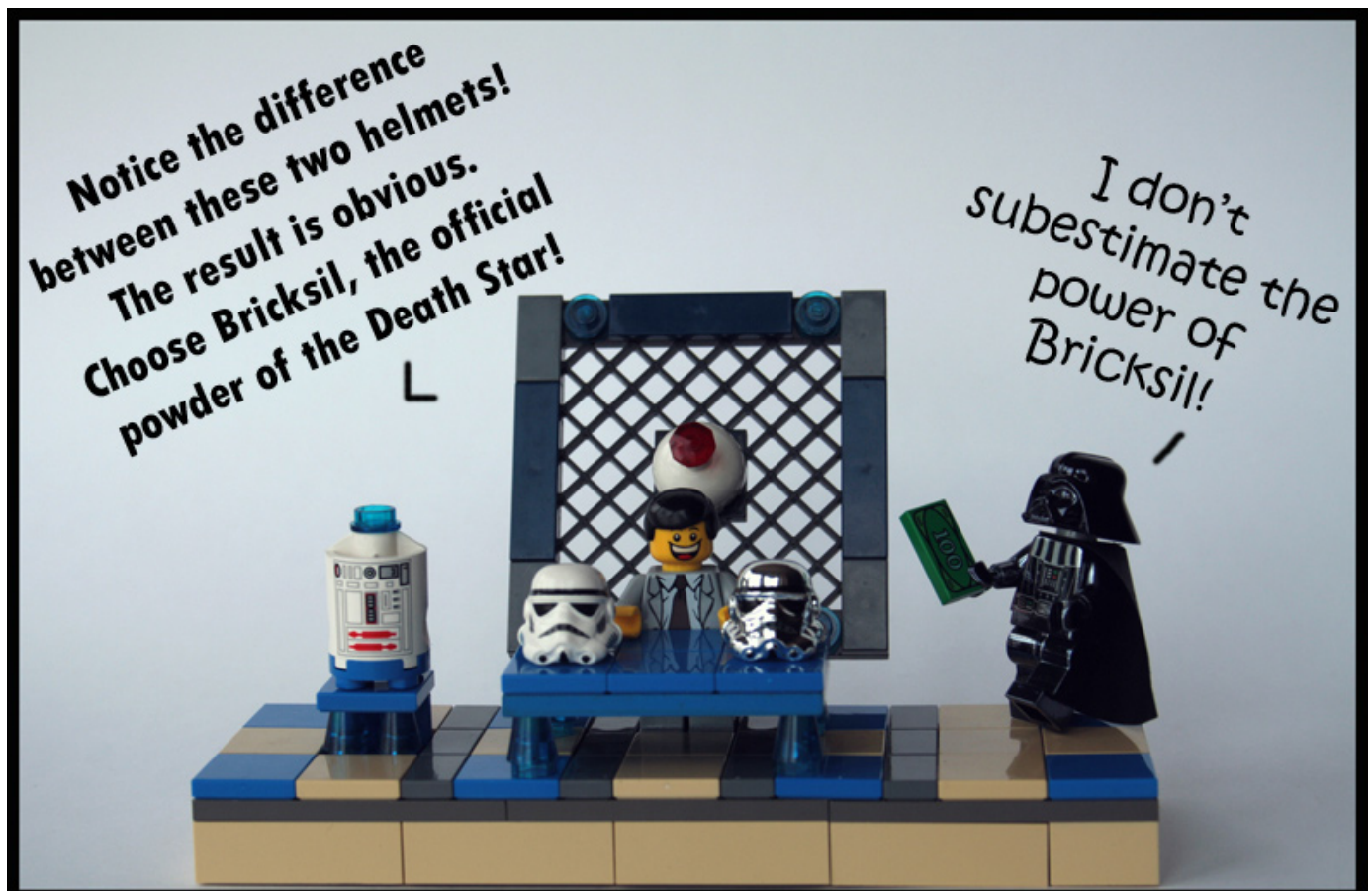
<http://sariel.pl/>

<http://www.flickr.com/photos/valgarise>

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