

RAILBRICKS™

BRICK RAILROADING MAGAZINE

BILLUND'S BIG BOYS

Miniland Trains up close and personal

RAILBRICKS Interviews
Carl Greatrix

More STEAM
Tips & Tricks



ALL ABOARD! TRAIN TECH



Train Tech Building Contest

Win an
Emerald
Night!



A Eurobricks and RAILBRICKS Joint Collaboration



Eurobricks

RAILBRICKS

Eurobricks is proud to announce a new comprehensive Train Forum, TRAINTECH! Due to the overwhelming interest in train topics and the large number of train fans joining Eurobricks, the Trains & Town forum is now being split into two separate forums. In honor of the new forum, Eurobricks has declared August 2009 as Train Month. Train Tech will have a number of new and exciting topics as well as a special building contest in which participants have an opportunity to win an Emerald Night, as well as two other prizes sponsored by RAILBRICKS e-Magazine for LEGO Trains.

Check out Train Tech today! <http://www.eurobricks.com/forum/index.php?showforum=122>

RAILBRICKS ISSUE 6

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ALL ABOARD!

Well, here it is finally, Issue 6. This issue has been long coming and its delay was entirely due to me. The reasons are varied and I won't bore you with excuses. I will, however, solicit your help. RAILBRICKS is currently looking for a page layout designer to join the team who is familiar with either InDesign CS4 or Scribus. A large part of each issue is putting it all together. We never seem to be short on content. In regards to that, we've brought on two new team members to actively blog to our website. Cale Leiphart and Anthony Sava have taken up the reigns here and have been doing an excellent job of posting news and MOCs as they happen.



We've also revamped our website to help accommodate our new bloggers as well as update the core software. This was made possible by our first run of custom train kits. We only had the kits on the site for a short while, taking the rest of them to Brickworld. The 25 kits quickly sold out. Thank you everyone who purchased a kit. I hope that you have found some building challenges and techniques that were unexpected.

RAILBRICKS is also attempting to embrace other community resources. We've teamed up with Eurobricks to help them kick off a newly revamped train forum. Be sure to head over there and jump into the discussions

We are also actively pursuing the idea of going to print. When/if this will happen is still unknown, but we will keep you apprised of the details as we get them.

Don't forget to also check out the build instructions section of the website. Consider submitting a creation as you browse around the community offerings collected there.

Enjoy the issue and thanks for all of the support. This magazine would not be what it has become without you, the LEGO train fan.

-Jeremy

All Instructions, Tips and Tricks, and REC Challenges are categorized into the following levels of difficulty

B

BEGINNER

I

INTERMEDIATE

A

ADVANCED

EMERALD NIGHT BROUGHT TO LIGHT

by Didier Enjary

Model Railroading, toy trains and LEGO

The LEGO Company (TLC) has produced train models for decades. Of course, as a toy, LEGO trains were only a rough modelization of actual prototypes and when based on specific real engine, the building constraints and parts (un)availability made the final design somehow faithful.

In the recent years, TLC gave birth to a new business line targeted to older kids, young adults and collectors, branded as 'Direct', which products are available on-line. This was the happening of more realistic and eye-catching train models, like the EMD F7 (Santa Fe Super Chief - 10020) and EMD GP 38 (Burlington Northern Santa Fe - 10133) engines or TTX Intermodal Double-stack cars (10170).



Emerald Night

Now what about the Emerald Night train set (10194)? Most train fans noticed strong similarities with British rolling stocks. RAILBRICKS makes a public inquiry and private investigation.

The Pacific Class A1, A3 and A4

The Pacific Class A1 was initially designed in 1922, by Chief Mechanical Engineer Nigel Gresley, for express main line passenger services on the Great Northern Railway (GNR) before it became part of the newly formed London and North Eastern Railway (LNER) in 1923 when Britain railways merged into the 'Big Four' companies.

The next stage in class A3 reflected the fitting of a higher pressure boiler and greater superheating surface to the same chassis.

Eventually all of the Class A1 were rebuilt to Class A3 specifications, only one of the later is surviving into preservation. British 4-6-2 «Pacific» steam locomotives reached their peak with the streamlined Class A4.

<http://www.lner.info/locos/A/a1a3a10.shtml>





© TLC 2009

About the LEGO Model

Why do people recognize the LEGO model as being inspired by the Class A3?

Firstly, it is a Pacific steam (4-6-2 wheel arrangement). Pacific is a configuration for steam engines, generally used as motive power for express passenger trains.

Secondly, highly colored liveries at this time are typical of UK engines. When most steam engines were painted black (or dark brown) in the world, British steams wore various colors from blue (LNER Class A4 Mallard) to red (LMS Coronation Class) and green.

Some minor details may mislead to German engines (deflectors) or American (cowcatcher) but can be easily explained given the colored history of Gresley Pacifics (for instance, dual blastpipe were fitted, making necessary the use of German-style smoke deflectors).

LRTS



© TLC 2009

The British train tenders sides held the company initials letters - LNER, GWR or LMS for example. The LEGO model features the cryptographic LRTS letters. What does this stand for? We got the unofficial answer that there is no official answer. LRTS means LEGO Railway Train Service or LEGO Railroad Transportation System or whatever you want. That's really up to you. A Frenchman, LEGO train enthusiast and play on words lover coined 'Le Reste du Train Suit' - The rest of the train is following - ironically emphasizing that with only one car, the train is quite short.

Passenger car



© TLC 2009

The passenger car which comes with the engine in the set, with its brown and tan color scheme, resemble beige and sienna colored British Pullman dining cars, seen for instance in the British Simplon-Venice Orient Express luxury train.



Improvements

For obvious reasons (playability, costs), the car model suffer a compression in length. LEGO trains enthusiasts may lengthen and enlarge the model to reach a more realistic look and more detailed interior. For instance, the engine cab being 7-wide, the cars could be built this breadth.

On the engine, the American looking cowcatcher-snowplow should be removed and replaced by a red bumper plate. If ever you buy two sets, you should be able to build a dual-tender train (as in modern times water supplies were harder to get, preserved steam engines was added a second tender) with one passenger and one dining car.

If you do not mind heavily modifying the design, you might even go as far as Carl Geatrix did with his own recreation of the unique preserved Class A3, the LNER "Flying Scotsman", using custom made green wheels and stickers.




A word on design process

You may wonder about the reason behind the design choice for the Emerald Night.

First, the colors. Dark green, tan windows, brown and chocolate carriage. The use of not-so-common colors is an obvious and direct consequence of LEGO Train fans wishes for long. Yes, TLC is listening to you.

It goes the same for the large driving wheels, which could be seen as an homage to Ben Fleskes BBB wheels. This but also the powering solution, Power Functions XL motor, naturally led designers to choose a steam engine.

And last but not least, the train has to be iconic, and the British Pacific locomotives are known worldwide.

To conclude, we are happy at RAILBRICKS to present this picture of the Class A4 reproduction by Jason Railton, UK Adult Fan of LEGO Trains, which creation has been presented to designers at Billund in early stage of development and which is in many ways the very first prototype of the Emerald Night train set. 



Benn Coifman's

REVERSE ENGINEERING CHALLENGE 6

I

This column seeks to challenge readers to look around at other builders' work and tease out how they achieved a specific effect, an important skill as you wander off the instruction sheet and into your own creations. I was enticed by the recent RAILBRICKS "modern steam" challenge to model the proposed American Coal Enterprises (ACE) 3000 from the early 1980's. The six-wide nose was among the greatest challenges in this design, so I thought I'd share the adventure with you.

The nose is somewhat reminiscent of an EMD F-45, with a pronounced slope both on the top corners and on the front vertical corners. These slopes present the first part of the challenge. Then, upon figuring out a solution to that problem, the presence of the headlights in the middle of the nose disrupts much of the space you would otherwise have



available to attach everything together.


Your challenge is to build everything from the tip of the nose back to the rear of the cab doors (except for the running gear below, i.e., do not worry about the wheels). This particular competition will be limited to pieces that were actually manufactured [1]. At the time I built this design the 1x1 slopes ("cheese bricks") were not available in green, so they will not be allowed in this entry.

Submit your solution to challenge@RAILBRICKS.com with the title **SIXTH REVERSE ENGINEERING CHALLENGE** in either ldraw format or provide sufficient digital photos on how to construct the car by July 1st,

2009. If you build a physical model, you can use more common colors. Be sure to include your name and contact information.

The editorial staff will select the best design from all of the buildable submissions that achieve this effect and winner will receive a "RAILBRICKS Challenge" engraved brick. We'll publish the solution in the next issue.

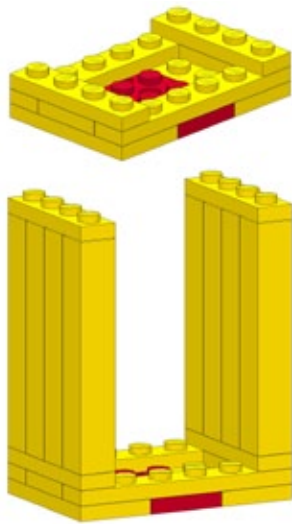
All submissions become the property of RAILBRICKS and by submitting an entry you will allow us to print your submission in whole or in part.

If you have ideas or suggestions for future challenges, contact us at submissions@RAILBRICKS.com. 

[1] <http://www.bricklink.com/catalogList.asp?catType=P&colorPart=6&v=3>

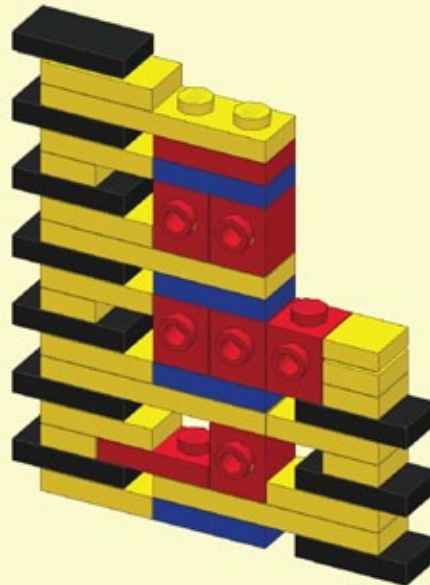
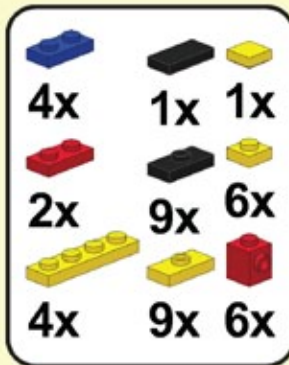


REC5 REVEAL

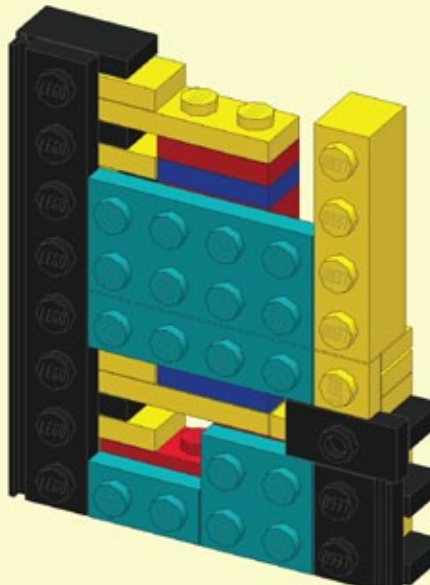
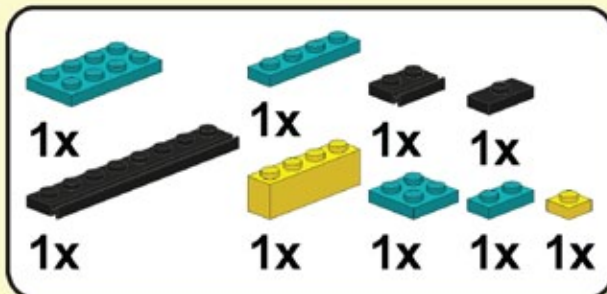


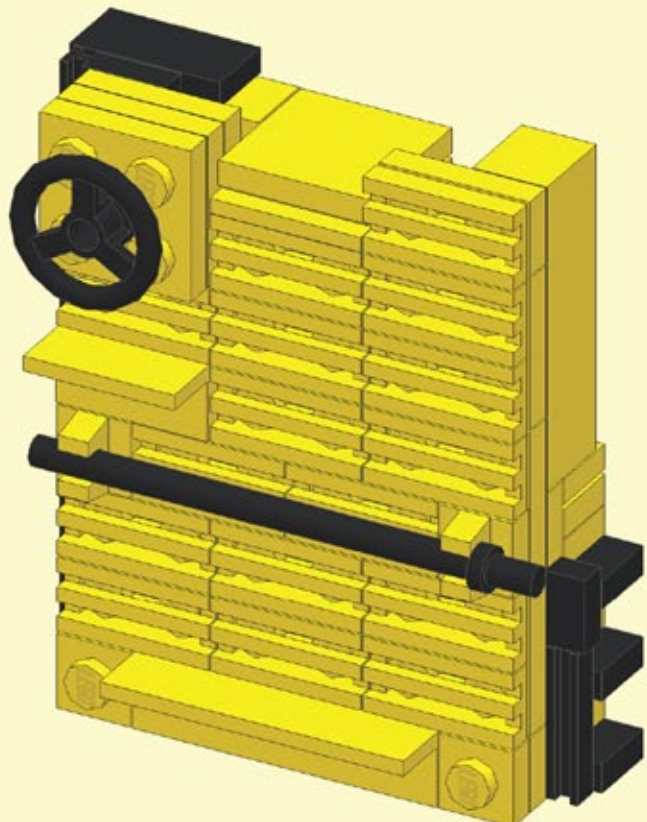
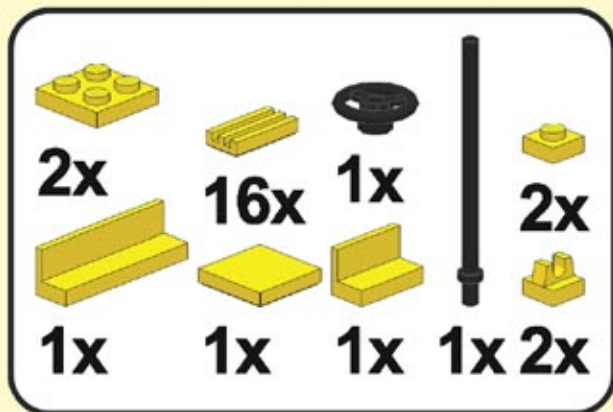
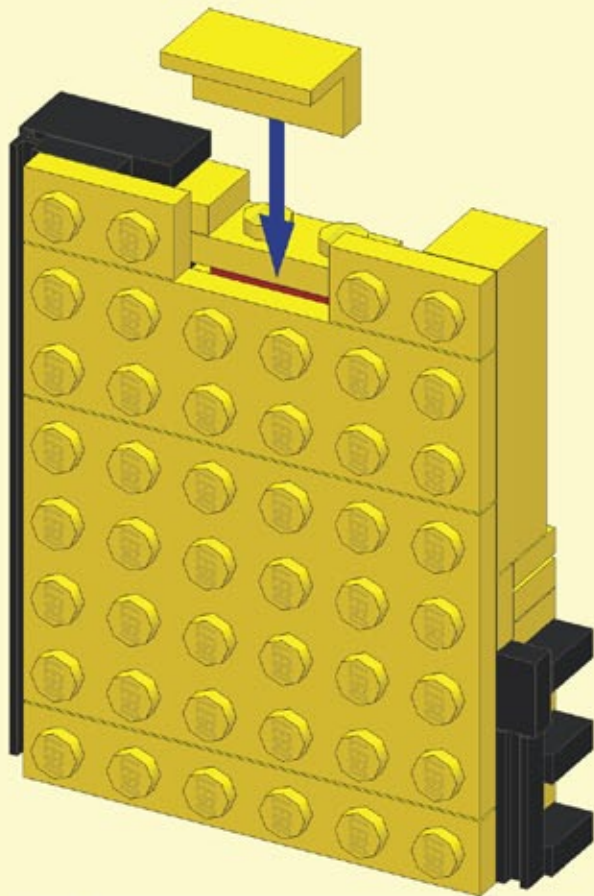
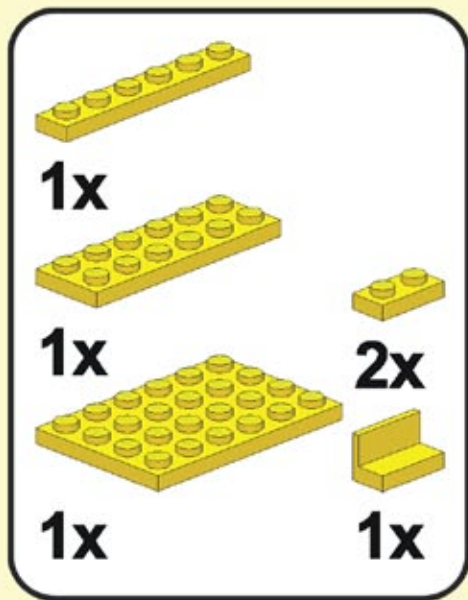
Congratulations to Ronald Vallenduuk for the winning submission for REC 5 and the coveted engraved brick. Ronald even got the small twist in the 1x1x5 bricks to mimic the wood sided car. This model has a lot of tricky features going on under the surface, e.g., the mix of jumper plates and door rails on the grab irons (the three rung ladder) and simply attaching the last row of slopes on the roof while also accommodating the SNOT below. The solution shows a very small deviation from the pattern in the 1x2 grill tiles to get the necessary studs all the way out to the end.

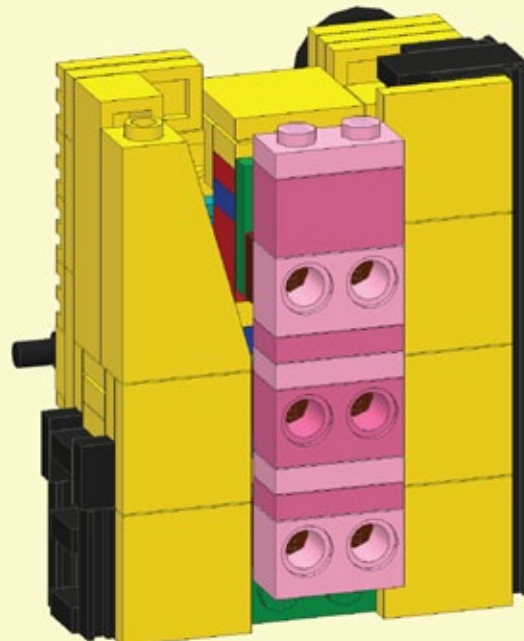
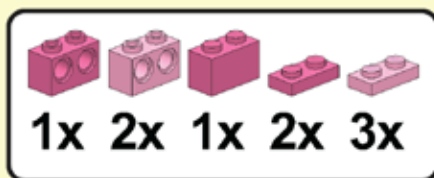
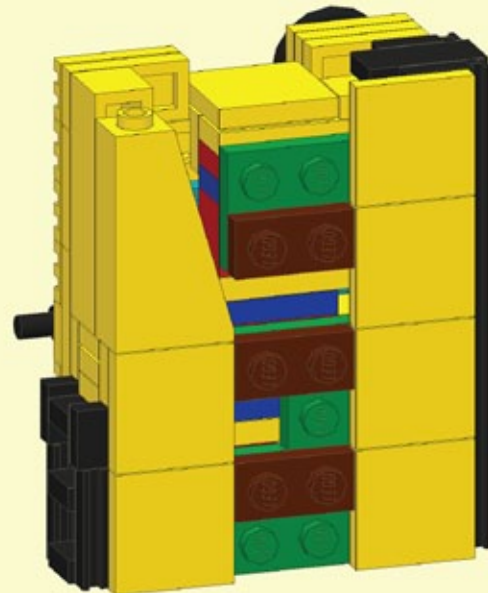
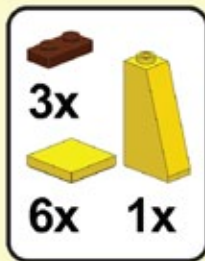
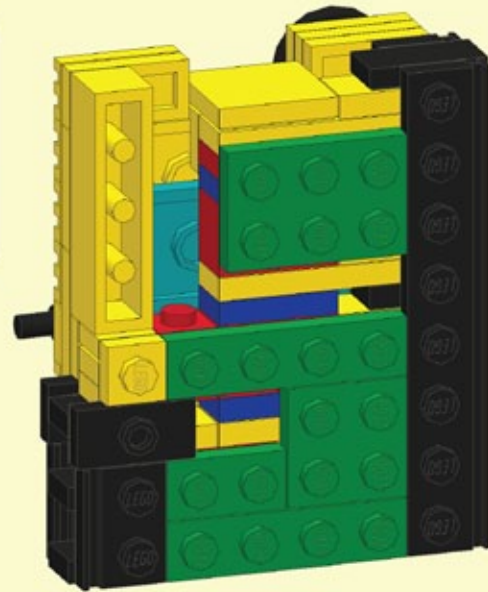
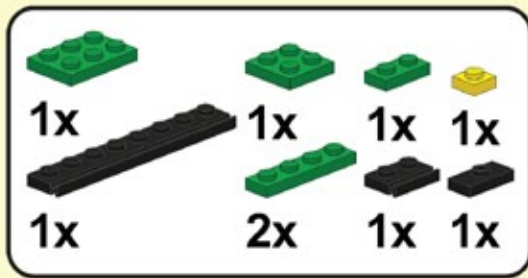
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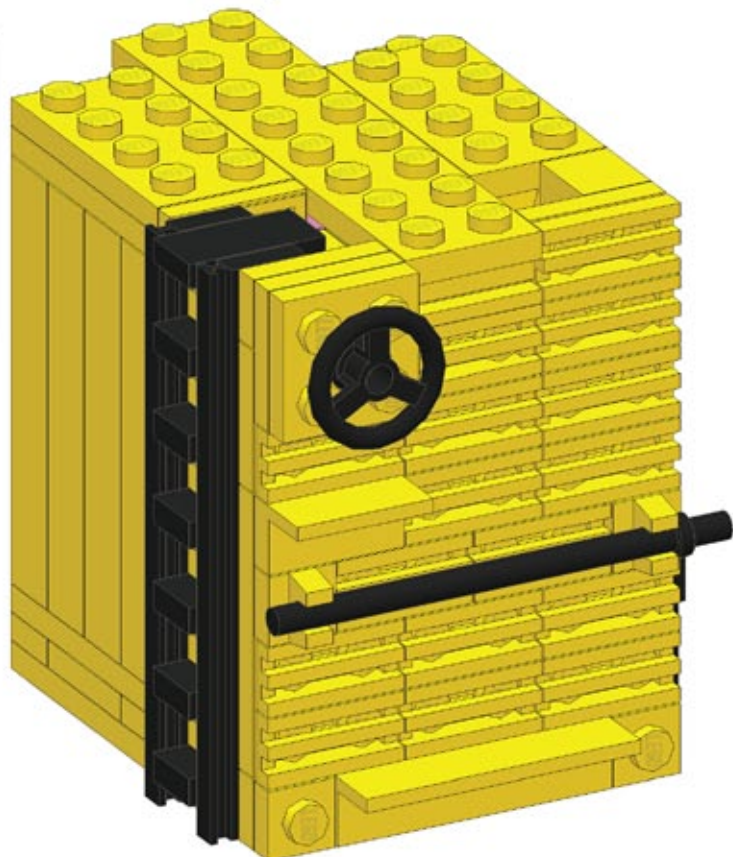
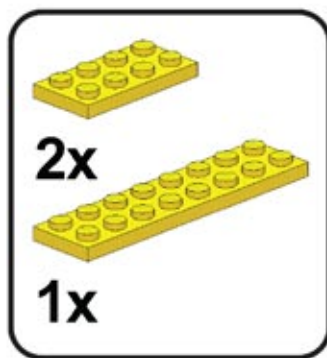
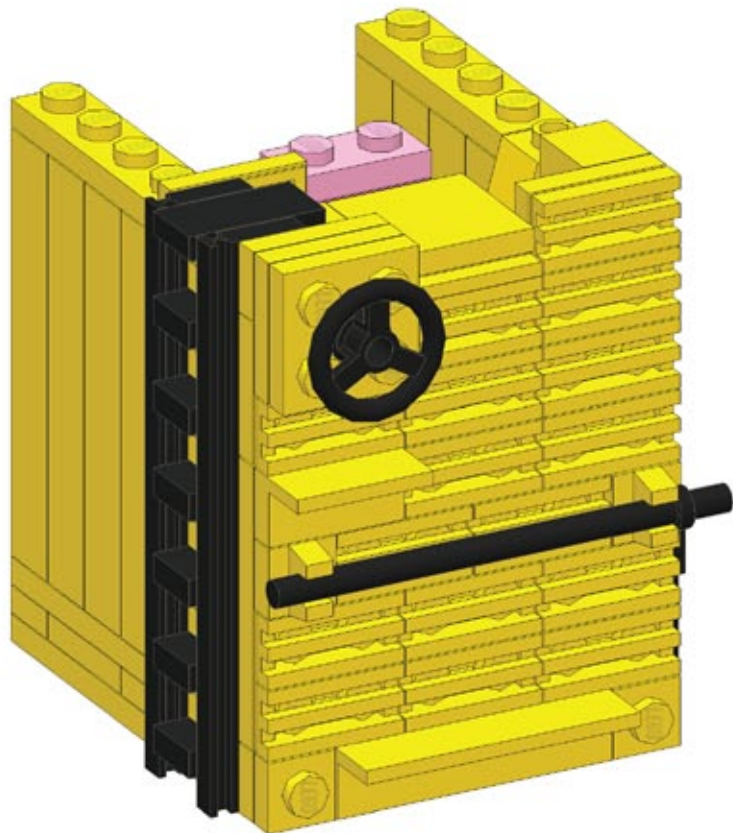


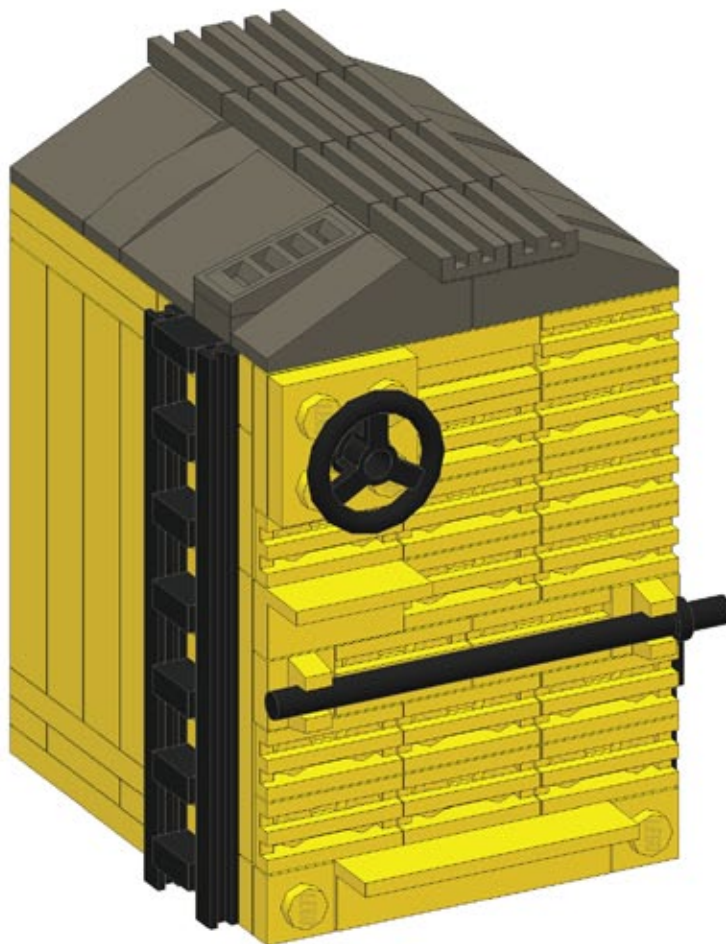
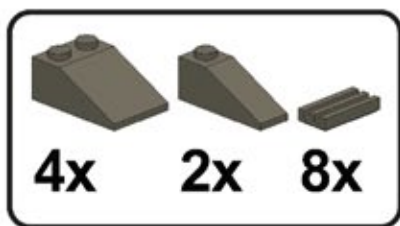
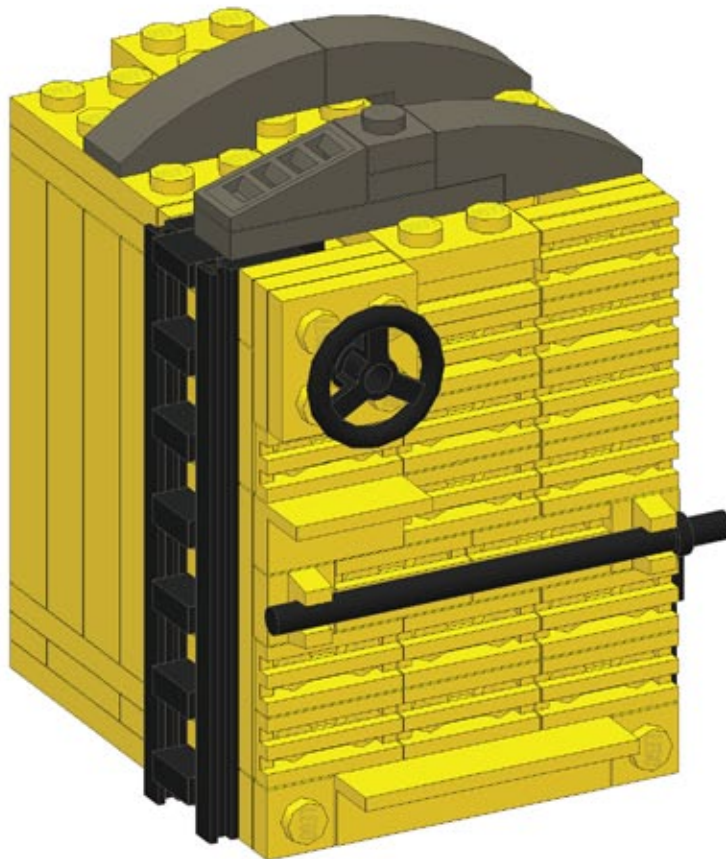
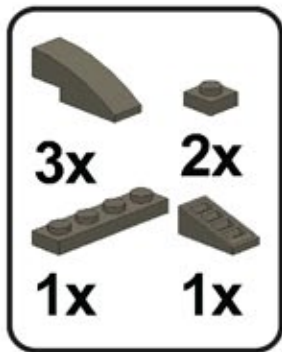
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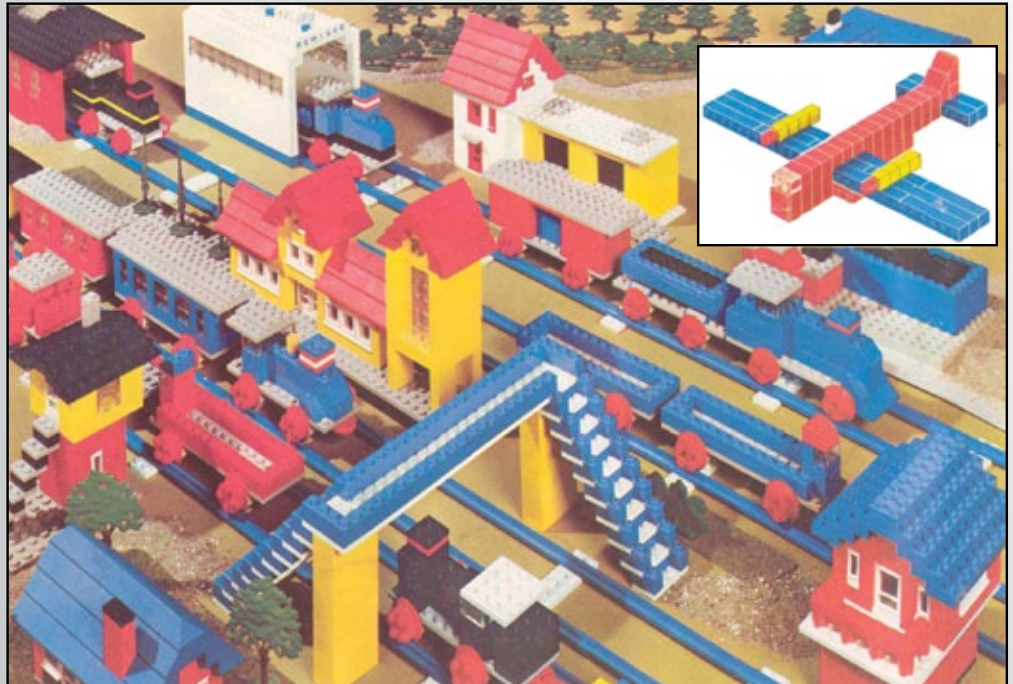






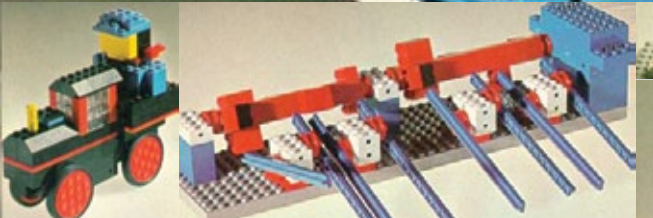
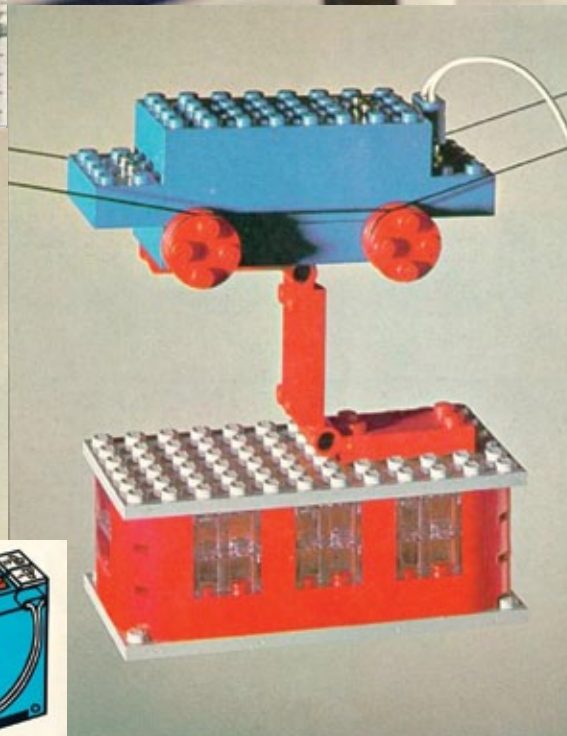
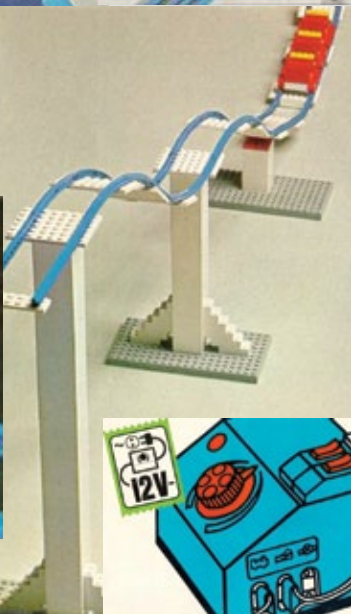
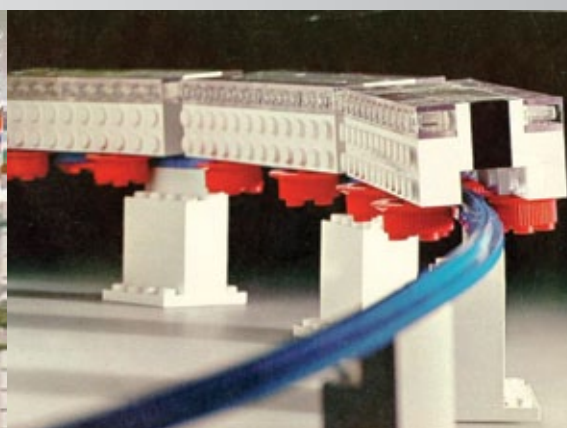


In this age of the internet we often turn to AFOL photo galleries for inspiration. As Lego ushers in the era of power functions trains, we thought it would be interesting to look back through the idea books over the years. The books span 15 years and LEGO's first three eras of trains, from push trains to 12v. The complete books can be found in the Peeron.com instruction libraries. Our first stop is a General Idea Book 238, reportedly from 1963, though it includes a battery train that was not released until 1966. This book was clearly transitional, it had several pages devoted to non-flanged wheel trains and a spread on 4-wide push trains. The book also featured several snotted designs including the airplane shown inset and a truss bridge built out of snotted-rail.




Next stop is the General Idea Book 240 that came out in 1967 and featured many 4.5v trains. Some of the more interesting ones include an 8-wide steam engine with two motors, each with their own battery box. And one of our favorites, a boy demonstrating the hard way his need for wireless control. By 1968 Lego answered this boy's need with the whistle controlled train power switch, which was subsequently featured in the Electric Motor Idea Books 241 and 242 that came out in 1971. While not explicitly train books, the majority of these motor books were devoted to trains in one way or another. To this day they provide a surprisingly prolific array of ideas. But the ability to start and stop afforded by the whistle was quickly overshadowed by the greater control offered by the 12v trains that were also featured in these books.

The next page highlights many of the designs from 241. The book includes a snotted monorail, a COFC intermodal facility, a cable car and ride on train. There were a few more truss bridges built out of snotted rail. Look how the plates are attached at the top of the example shown, the designer inserted a plate edgewise between the tubes on the bottom of another plate. The hinges on the engine house doors were very resourceful for the days before clips and bars. The book shows an older Super Chief design (notice the round building in the background) and they even foresaw the recent rise of roller coasters built of snotted rails.



While many of the same models were featured in 241 and 242, the latter differed from the preceding books by including instructions rather than simply assembled models.

Another General Idea Book, 222, was published in 1975. Much of the book was devoted to the Homemaker macro-figures. Several pages show the macro-figures placed uncomfortably in and around the older 4.5v train sets.

The trains finally received their one and only dedicated idea book, 7777, in 1981, and what a book it was. A favorite among collectors, it continues many themes begun in the earlier books. But it now focused squarely on the then still relatively new mini-figures and offered a bit stronger narrative flow than the earlier books. Among the highlights, it foreshadowed the BNSF (set 10133) and the tools in the Train Engine Shed (set 10027) note the drill press, lathe, and crane. One can not help but look longingly at the long string of OEM remote controlled switches and block signals from the 12v line that were featured in the layout. 



TEST REPORT:**New Power Functions Train Accessories***by Brian Williams*

Ever since TLG's 2007 press release announcing the discontinuation of the 9v train system, train fans worldwide have eagerly awaited a new train system based on Power Functions components. Well, the first accessories of this new system have now arrived and RAILBRICK's Labs has been hard at work testing them. At the core of the system are a new rechargeable battery and variable-speed remote control.

Below is the full list of Power Functions Train Accessories (prices shown 4/28 at LEGO SAH). These can be purchased individually (shown below), bundled together (#K8882 for \$99.99), or bundled together with the new Emerald Night and flex track (#K10194 for \$219.00). Note that the battery has a built in speed regulator so if you don't need IR control then you may elect to purchase only the battery, transformer and a motor. If you buy bundle #K8882 then you save \$19.45. With bundle #K10194 you save \$24.99 (basically get the flex track for free).

#8870 Power Functions Light - \$6.49
 #8878 Power Functions Rechargeable Battery Box - \$49.99
 #8879 Power Functions IR Speed Remote Control - \$12.99
 #8882 Power Functions XL Motor - \$9.99
 #8884 Power Functions IR RX - \$14.99
 #8887 Power Functions Transformer 10VDC - \$24.99

These new accessories were tested on several stock Emerald Nights over a two day run on a 12'x20' club layout. The track was level with long straight-aways connected by standard LEGO radius curves



in the four corners. The new #8878 Rechargeable Battery Box contains a 7.4v 1100mAh Lithium Ion Polymer battery. Compared to other battery technologies, Lithium-ion batteries have higher energy density and hold a charge longer. The battery took approximately 4 hours to charge and ran for a little over 3 hours pulling the stock tender and 3x stock coaches from the Emerald Night set. Speed was constant over every run up to the point when the battery turned off. The battery contains an internal speed control allowing stop, 7 speeds forward, and 7 reverse which provide a very practical speed range for the Emerald Night allowing it to creep on the low end and not go excessively fast on the high end. The max speed of the rechargeable battery output was measured to be the same the regular 9v PF battery pack so no pulling power is lost due to the 7.4v LIO battery. Of course, train speed and pulling power is partly dictated by the gear train so when building custom en-

gines one can employ whatever gear reduction is desired. Also, two Emerald Nights were double headed, each stock using separate rechargeable batteries, and performed very well together as the speeds matched closely. An Emerald Night was also tested using the smaller PF motor but found to be underpowered for pulling cars.

Now for the best news: the charging algorithm automatically begins charging the battery once the charging jack is inserted (voltage is applied). And the battery can be recharged continuously while the battery is discharging. This behavior was verified as the Emerald night was run down several feet of straight track with the charging jack inserted and the battery charging. OK, so what does the all mean? First, it means that battery packs can be easily charged in place without removing. Just attach two sprung contacts to the bottom of an engine and park it over a special charging track to recharge automatically (possibly using old 12v center rail). Also you could theoretically run a PF locomotive on 9v track with the battery wired to an old 9v power truck with the motor removed (so that it acts as a power pickup) to continuously charge the battery while running... greatly extending the run time.

The new #8879 IR Speed Remote Control has the same styling as the older PF remote but is wider and uses two large rotating knobs to control speed levels (unlike the R/C train controller which used

push buttons). Like the battery, 7 speeds forward and 7 reverse are available for each of the two controllable functions. Switches are provided for reversing function direction and "emergency stop." The remote works with the same #8884 IR(Infrared) Receiver which has been available for some time and is wired between the battery and motor. In theory, the remote increases the power levels step by step as you turn the knob one direction, and decreases the power levels as you turn it the opposite direction. In practice, the IR signals sometimes don't reach

close proximity with no obstructions. The other (potential) issue plaguing IR control is that only 8 locomotives can be operated simultaneously (2 functions x 4 channels). Most home layouts probably won't exceed this limit. Clubs operating multiple trains might. But large shows with multiple train clubs (Brickfest, Brickworld, NMRA, etc.) will almost certainly have PF channel conflicts at some point and may have to manage PF channel use similar to the way that R/C aircraft clubs manage channel usage on flying fields.




the locomotive so the knob must be turned further to compensate. The problem is that buildings, tunnels, and crowds of people (in a show environment) interrupt the line of sight required for the receiver to "see" the signals from the remote. Even along an open stretch of track it was sometimes hard to obtain precise control. So the remote is really best used in

Lastly, while this report is really about the new PF accessories, here are some lessons learned from the testing about the Emerald Night itself. First, the locomotive has good balance with its weight centered on the three drivers. But the truck wheels, especially the front one's, often struggle to turn partly due to lack of vertical play on the trucks, and

partly due to the use of axle pins which have high friction. Rebuilding the trucks using lower friction axles is recommended along with attaching the truck using a thin liftarm to provide more vertical play. Second, the drivers tend to bind occasionally when the backs of the Technic pins attaching the siderods to the drivers catch on holes in the Technic beams and plates of the surrounding frame. Sanding the backs of the Technic pins down slightly improved the running properties but rebuilding the frame to avoid places for these pins to catch is a good idea too. Third, the other issue causing the drivers to bind sometimes is the piston rods kinking. Each piston rod is run through a single perpendicular axle and pin connector "cylinder" which is a little loose, probably to compensate for the piston axis being higher than the driver axis. The best solution would be to drop

the cylinder axis in line with the drivers and lengthen the cylinder from 1 to 2 studs, although truck clearance would need to be worked around. Forth, sometimes the Emerald Night can derail on curves if the wide PF cord become kinked between the cab and tender so prevent that by providing adequate cord slack. Lastly, a number of people have commented on the bright red rubber bands used on the Emerald Night. Yes, these are needed for traction and don't worry... they quickly turn black after a couple hours of running.

So do these new PF accessories meet expectations? Well, LEGO has done a good job of delivering what they advertised and the new components are definitely a step up from the R/C train control for the advanced LEGO train builder. The components are solid and flexible enough to build into

most trains. The minimum PF entry cost to get a locomotive running (PFmotor+battery+charger) is \$85.00. That's \$18 more than the \$67 minimum retail cost for 9V (9v train motor + speed regulator) but remember that the 9V train prices are from 2002 so the new process aren't so much higher considering inflation. Having said this, I think that many current train fans already have a significant investment in 9v equipment and will wait to convert. What will get them to move over will be the all the cool new things that train builders figure out how to do with these new PF accessories. There are plenty of applications which are now possible including remote lights and horns, automatic speed regulation in response to trackside signals, and remote decoupling. LEGO has delivered... now it is up to us in the community to deliver our part. 





Interview by Jeramy Spurgeon / photos by Carl Greatrix

If you've browsed around Brickshelf or Flickr lately, you would be nearly impossible to have missed some of the magnificent work by Carl Greatrix. His attention to detail and mixture of mediums drew RAILBRICKS to interview him. When we caught up with Carl, it was at a turning point in life for him, and one that I think will nurture his hobby for some time.

RAILBRICKS: Hi Carl. Thanks for the taking some time to answer a few questions. To start things off, tell us a little bit about yourself.

Carl Greatrix: I am flattered that you should want to feature my work. I am 40 years old, live in the Midlands, U.K and I am a member of www.brickish.org adult LEGO building club. My first child memory is from two and a half years old, playing underneath the dining table with Sticklebricks at my grandparents with my parents returning from shopping with my first LEGO general brick building set, this was the start of a life long love affair! I'm very much a creative individual with a huge driving passion throughout my life of wanting to start creating

something from nothing and resulting with something that I'm really happy with. I am an accomplished modeler and scratch builder along with being a trained illustrator, designer and cartoonist and have owned my business www.cartooncars.com for the last 15 years.

RB: We understand that you've recently been hired by LEGO. Congratulations! What sort of position will you be filling? Will it allow you to incorporate any of your LEGO train interests?

CG: Thank you, although I need to correct you. I am now working (will be by the time of print) for TT games, (part of Warner Brothers) as one of the LEGO model

designers for some of the official LEGO games. I am hopeful that my train building interests will be incorporated at some point, but can't elaborate any further.

RB: You approach layout design a bit differently than most LEGO train fans. You incorporate traditional model railroading techniques such as natural looking grass and trees. What made you decide to go this route? How do you think the co-mingling of the two media has fared? Have you had any negative fan reaction?

CG: I initially took this route purely for personal interest. I didn't initially intend to ever photograph it and make it public....but I ended up doing so! I like to try

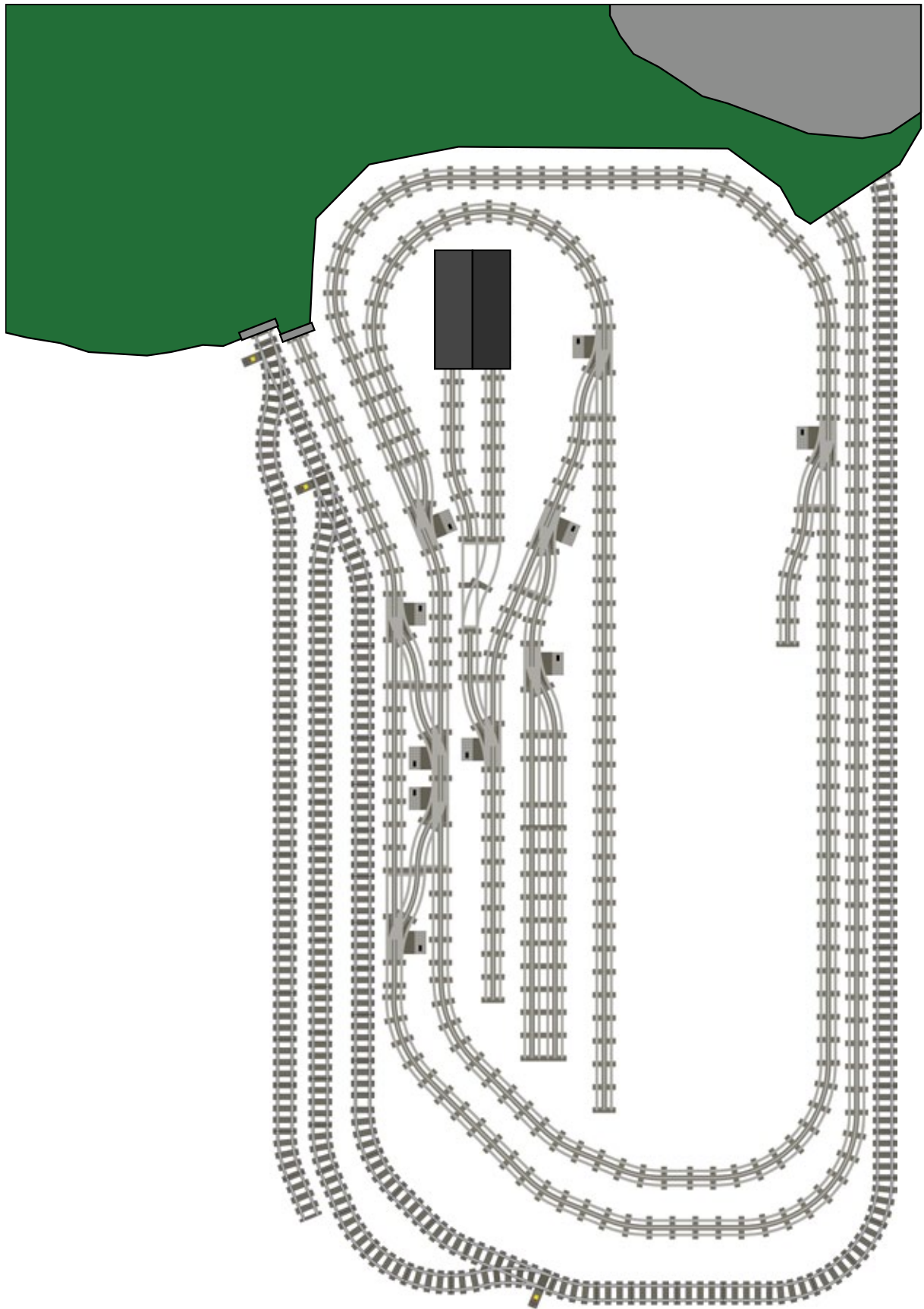
different things, my business is a good example of this as it was a niche product when I started. I create cartoons with the edge of realism. I felt that combining traditional model railway grass and rocks along with LEGO, puts slightly more realism into the layout whilst still combining the fun factor of LEGO. I like to call it "serious fun!" LEGO is one of the most creative products available in the world, so be as creative as you can with it, I personally think, if that involves combining two different mediums to blend and enhance each other, then from a creative artists perspective, its job done! It's had a few raised eyebrow reactions which I thoroughly expected. To my knowledge I have never had negative reactions to it. I know some guys are really starting to warm to the idea and

the final results now. Personally, I feel if the mix / balance of the two is just right and not over-done, that the overall effect is very nice. I was not keen on using all LEGO elements for grass, rocks, soil and ballast as I feel it is too shiny and reflective, in nature these elements are not, so I just wanted to try something different and view the results, I also hoped it would soften up the hard edged look that LEGO layouts can sometimes have. I'm very happy with how it's turned out. I know I'm perfectly capable of producing scenery to a good result in LEGO, I just wanted to push my personal boundaries further and also perhaps the boundaries of what's generally accepted within the modelling community. Hardcore purists are never going to agree with what I do, but the world would be a very



uninspiring place to live if everyone was able to please everyone. I certainly don't hold anything against someone thinking that I am breaking some "unwritten law" of legal LEGO building! I also hasten to add that TLG use a mix of non LEGO elements such as rocks, ballast etc in some of their promotional advertising photographs, purposely to enhance their product.





RB: You've created a beautiful rendition of the iconic 'Flying Scotsman'. This seems to be the same prototype that LEGO based their newest set, the Emerald Night'. Did you create yours in response to seeing the new set pictures or has it been in your roster for a while?

CG: My version has been built for the last 6 months...it was bad timing! I wanted to make the pictures public only when I had it 100% completed with all the stickers... these have been custom made... my father sadly passing away just after it being built obviously delayed the final touches by some considerable time. It was only after building the 9F Evening Star that made me want to do another steam build, I had purposely stayed away from steam engines up to this point, as I knew I would never turn back once started with them! I needed to incorporate two motors into the build to give enough pulling power as this was something the 9F suffered from using only one motor. Upon researching for previous LEGO Scotsman builds, I was extremely



surprised to find out that there are no public brick builds of this world-famous train,... that was something that I was determined to rectify, such a piece of history deserves at least that amongst LEGO builders! My main goal was to do the original as much justice as possible, plus maybe experiment further with modified LEGO parts in the making of the rods to try and allow a slimmer running width with more movements, just to give it more of a "wow" factor when in motion, at least to myself if no-one else. It did have a

complete correct rod / valve / piston movement which came out to just over 8 studs wide....as the parameters within our club are 8 studs wide for station clearance, sadly I had to remove parts of it to avoid platform collisions, but I'm still happy with the overall result now.

RB: Speaking of the Emerald Night, what do you think? Is LEGO moving in the right direction with their new train line?

CG: From a model train





perspective, they are certainly a further step forwards with it especially in comparison to their last steam models.

RB: You also incorporate 12V with 9V. Are you looking forward to adding Power Functions to the mix? Without having the new system in hand, what are your initial thoughts on LEGO's move to Power Functions over 9V?

CG: These are my personal opinions and do not represent the thoughts of Brickish, I have no interest in any battery operated system. I can thoroughly understand the reasons TLG have taken this route, but I'm only interested in track powered systems. At 11 Years old, I was awake at 5am Christmas morning opening up THE BEST present I have ever received even still in my life now. 7740 12v train set! I had it all built and running by 7am, can you imagine my own and my parents disappointment if it had been battery operated and I had run them to death by midday?!.... point made I think, not just for Christmas day, but any valued time spent operating it!....I hasten to add that the motor and track in my 7740 are STILL working perfectly, 29years later!

RB: What would you like to see from LEGO going forward? Anything in particular that you feel the Train line is desperately lacking?

CG: From an adult builder and train enthusiast's perspective, I can see lots lacking, but I also realize that this line is aimed at children first and foremost, so I'll always do my best to work with what is available. Personally, from a steam enthusiasts perspective, I'd very much like to see a return of parts similar to the old 12v rods. Something that is smaller, thinner and more realistic looking than a huge holed, thick technic beam, allowing more working parts to be used for more complex rod assemblies whilst keeping the maximum width of engine and drive gear to a minimum. I'd also love to see sound modules produced that

could be built into track powered rolling stock or engines and some working steam generators,..... although I imagine obvious reasons would probably prevent that for the younger market.

A further useful part would be a 5 stud wide cylinder, for building boilers in the right scale (as I think 4 studs is too narrow and 6 is too wide) and I do wish they would start making larger width, shallower curved slopes that could be used for roofs and carriage sides.

RB: You seem to capture details in your models that are often difficult for other builders to achieve. How do you go about designing a MOC? Do you work from schematics and prototype pictures? What other, perhaps unorthodox, techniques do you use to enhance a MOC?

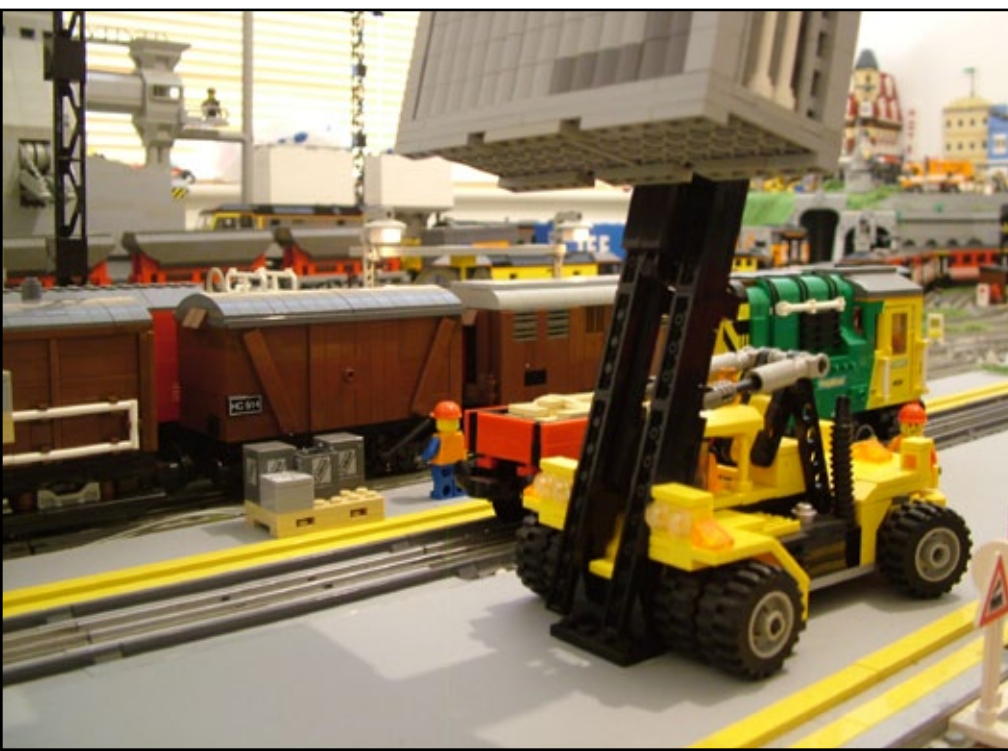


CG: Research, lots and lots of research is my main factor. I may have an idea of a particular engine or wagon that I want to build, or I may see a small image somewhere that has something within it that just piques my creative juices. From that I will spend endless hours searching for better and better images and whilst looking through the images that are useful, I will start to form ideas in my mind of how I will achieve certain parts of the build.....sometimes I will go straight into LDD and experiment with my ideas although usually I will go straight into real bricks as I like to have a hands on physical build in front of me. I've never really used schematics, only photographs or models, although models are never usually 100% accurate for details. The devil is in the detail, I'm known for detailing in my business and in the scratch built models I used to make so this naturally reflects in trying to produce as much detail as possible in my LEGO models. I'm a firm believer in small details make a HUGE difference to an overall effect and



I get an excitement and great personal satisfaction in both seeing the result and knowing I've done my best to achieve it. My goal is to have an end result that looks as realistic as possible, rather than looking like a typical LEGO brick build, I want people's first reaction to it as being, "is that a model, or is it LEGO?"...The "wow" factor is usually emphasized when they then realize it is actually LEGO! Once I have a model finished, I try to use any down time I have to sit and look at it from all angles and distances, to see if there is anything I could improve upon, any parts that are bugging me, etc. Its at this time that if anything arises,

usually results in the model getting completely redesigned in one area or another....that's the bit I dislike, as days ago I may have thought it was finished!.....this is also the time that some unorthodox approach may be looked at, to compare that against my initial purist build to gauge if the use of a cut or modified part is justifiable for a personally considered better finished look, smoother line, etc. A good example of this is the sacrificed 12v rod in part of the Scotsman's rod movement....I considered that worthwhile doing as it added to the overall look and feel of the assembly plus certainly looks much sweeter



when in motion. If I ever decided to take the knife to any part, it is purchased especially for the job, rather than using existing parts from my sets. I also use stickers a lot throughout my builds, I get ribbed for it a fair amount by guys in the club, but I laugh along with them. Personally I see no problem with the use of them, TLG include and use them in some vital parts of their models very creatively and have done since the 70's....I used to make my own for my MOC's when I was a kid and I'm certainly not about to stop now. Some say its a lazy cheating form of building, I strongly disagree with that and say it is another expression of creativity which allows boundaries to be pushed raising the standards of finished builds to a different dimension. Unorthodox techniques that I use are the cutting, heating and bending of any tube, flex rod or bar elements that I feel are needed for added detailing.....it usually depends on what I have available to me at the time and the desperation of seeing the results in comparison to a perfectly legal build. I find half the time, that when I picture something in my mind, it does not look as good



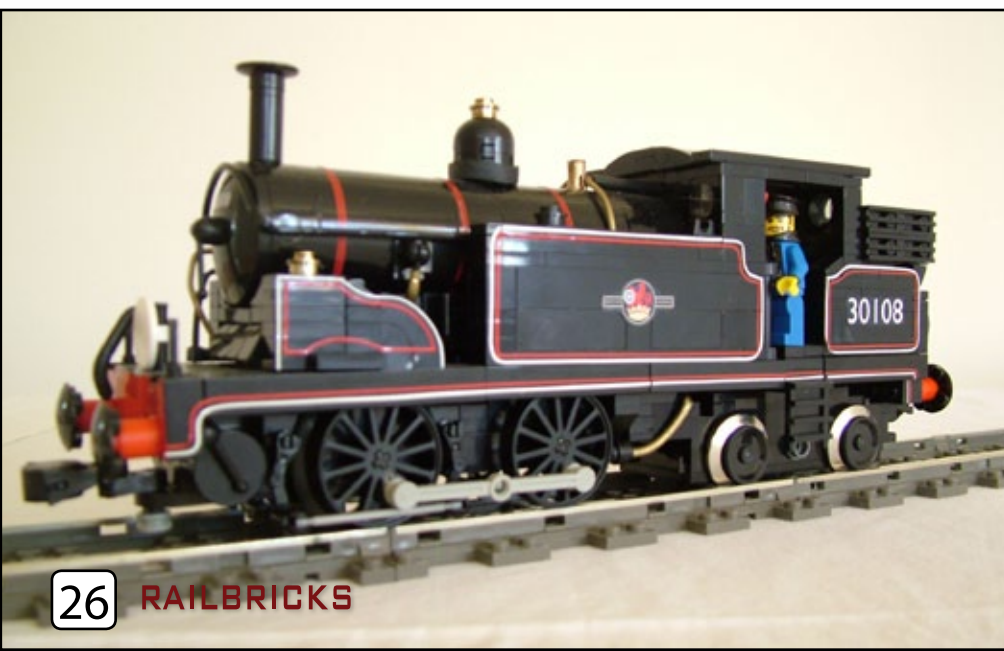
in the brick, so I experiment and experiment with different techniques or mods until I feel it does look good. A further unorthodox method I have dabbled with is the use of brass rod rather than LEGO rods and tubes. It is the same dimension and bending properties, it just gives a more realistic color for personal preference rather than using a pearl or brown LEGO element the same. Some have said its a step too far, but it can be replicated in LEGO, and if it inspires at least one person to try a new build away from their "comfort zone" then I'm happy, as that is when the most interesting builds start to occur and the bar starts to get raised further.

RB: Being a British builder, it seems obvious that your inspiration comes from railroads in your country. What is your favorite road (livery) to model? Why?

CG: I don't really have a favorite modern day, I like to model engines and liveries that I feel will look good in LEGO and that I have never seen built before....most U.S engines have all been built in brick extremely well, the U.K has a lot of potential that has rarely been tapped into, so it was a logical decision to "stay at home!" I do have an affection for the class 37's, not the easiest engine to reproduce but I want to keep revisiting different build methods with them. I have managed to get them sounding clanky using various pistons and internal motors, but I really won't be happy until I get one that splutters thick black diesel fumes out of its roof fans!

RB: There seems to be a good mix of both Steam and Diesel in your roster. Is there a certain time period you prefer to model?

CG: I like the 70's - 2000 period, its what I grew up with....at the time I didn't particularly have any





affection towards it, but now its all history, it makes it more special for me. I especially like the dirty, grimy, noisy side of railways, and trying to model more of that aspect. My home layout is based around that period with a couple of later year engines making an appearance. The steam side of building won't ever go on my home layout, (the layout parameters were not designed for large overhanging steamers!) although 2 or 3 of the smaller variants do run around it from time to time, just to keep my passion of watching them run at bay! I'm completely hooked on building steam engines now, and I'm making a complete modular portable layout expressly for this era trying to focus on the 40's-60's with mainly "British Railways" engines.

RB: You excel at architecture as well as well as you do at creating Train engines and rolling stock. Your recent creation, Corfe Castle Station, is a wonderful example of this. Often builders neglect the backdrop to their creations. Do you feel that scenery is just as important as the trains that run through it?


CG: It's detail, as previously discussed. If you have the space and resources to be able to build scenery, buildings, etc which obviously some builders do not, then its the icing on the cake to compliment the rolling stock.....even if its just a plain green field with a few fences, it completes the illusion. Plain white backgrounds are perfect to set off and focus on an exceptional model, although I feel there is nothing better than viewing an

exceptional model against an exceptional background setting to paint the perfect picture!

RB: Has your background as an artist aided in your creative process when tackling a new MOC?

CG: Absolutely!

RB: Tell us a little bit about what we can expect to see from you. Are you expanding your current layout?

CG: My current layout is still very much an onward work in progress, I have no room whatsoever for expansion, just finishing detail, ballast, grass, more lighting, etc. The new expansion is the portable steam era layout. You will certainly see more engines, carriages, tunnel mouths, bridges, embankments, slate walls, canals with barges and lochs and some steam traction engines.....I have an idea to try and have these moving within the layout also that is still very much in experimental stages. If successful in design you will also see complete mosaic scenic backboards to complete an overall look with depth of field. 



Building Up Steam

THE NUTS AND BOLTS OF RUNNING GEAR

part 2

Welcome back to the this second in a series of articles on building LEGO steam engines. Last time we covered the basics of steam and general considerations for building an engine. Now it's time we take a deeper look at the various techniques you can use to make that engine of your dream. And we'll start with the running gear.

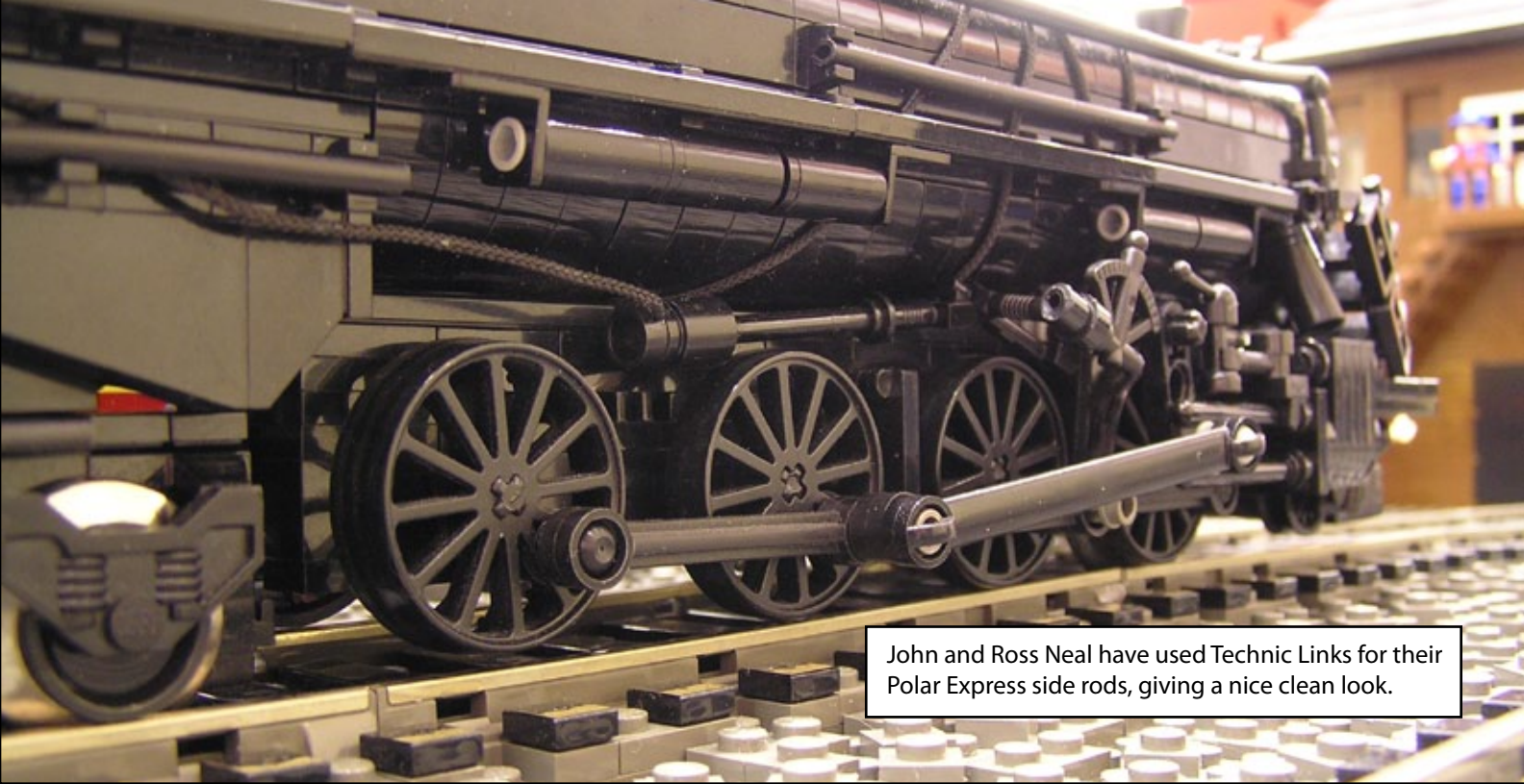
So what do I mean when I'm talking about running gear? Specifically I'm referring to the wheels of the locomotive the connecting/drive rods, pistons, and other details directly attached to the wheels and the frame that supports it all. One could also include the tender trucks but I'm going to save that for a later date and just concentrate on the engine.

I always start with the running gear when I begin building a new steam engine. The reason is simple. The running gear is the foundation of a steam engine has a profound effect on how well the engine runs. I don't build static engines. I build my engines to run and I want them to run as smoothly as possible. No one likes to constantly fix an ailing engine especially if you're at a public show. So the first item on my build checklist is getting all the kinks out of the running gear.

Since we'll be referring a lot to pilot trucks trailing trucks and terms such as 4-4-0 and 2-8-2 lets recap the Whyte System for classifying steam locomotives by wheel arrangement. Whyte's system counts the number of leading wheels on the pilot, then the number of driving wheels (the wheels actually driven from the pistons and connecting rods), and finally the number of trailing wheels with the groups of numbers being separated by dashes. Thus, a locomotive with two leading axles (four wheels, two per axle) in front, then three driving axles (six wheels) and followed by one trailing axle (two wheels) is classified as a 4-6-2. Articulated types such as my Norfolk & Western Y6b (Y6b was N&W's class designation for this particular loco) are effectively two locomotives joined by a common boiler and have extra groups of numbers in the middle. So the N&W is a 2-8-8-2. There is one leading axle, one group of four driving axles, another group of four driving axles, and then one trailing axle. Simple right?

So you now have an understanding of how the wheel arrangements of steam engines are broken down. But what wheels do you use for building your LEGO engine. The good news is that

you have several great options. My personal favorite are the drivers and train wheels from Big Ben Bricks <http://www.bigbenbricks.com/>. Ben Fleskes has been selling his custom wheels to the LEGO community for several years now and many train enthusiasts can attest to their quality and versatility. Big Ben offers large and medium drivers in both flanged and blind styles as well as well as a small train wheel. The wheels are connected via a standard LEGO Technic axles and have provisions for mounting side rods via Technic pins. Before the advent of Ben's wheels steam builders used various LEGO wheels and even sometimes gears to represent the drivers on their locomotives. I don't personally care for this style as very few of them were designed with trains in mind but if you want a pure LEGO solution or a wheel size that Ben doesn't offer then they are an option. A third option is the drivers about to be introduced in the new Emerald Night set #10194. Since this set is not yet available as of this writing I can't comment on them with firsthand experience but from the photos I've seen they appear to be similar in size to Big Ben's large drivers. So in theory any techniques used for Ben's wheels should work for LEGO's new drivers. Most of the



John and Ross Neal have used Technic Links for their Polar Express side rods, giving a nice clean look.

will see in this article involve Big Ben's wheels since they have become pretty much standard for LEGO steam and are the most versatile option.

Now that we have our wheels let's move on to arranging them into something beginning with the drivers. On a steam locomotive, a driving wheel is a powered wheel which is driven by the locomotive's pistons. On a conventional, non-articulated locomotive, the driving wheels are all coupled together with side rods. Normally one pair is directly driven by the main rod (or connecting rod) which is connected to the end of the piston rod; power is

transmitted to the others through the side rods. The driver size you choose is up to you and the particular locomotive your modeling but the techniques presented here should work for all sizes. Ben's drivers use a LEGO Technic axle for connecting pairs of wheels with the axle then usually riding in a Technic brick. Different wheel spacing can be achieved depending on which holes in the Technic bricks you use.

If you study locomotives built by some train builders you may have noticed that some of the drivers they are using don't have flanges. Some real life long wheelbase locomotives (usually with four or more coupled axles) were equipped with blind drivers. These were driving wheels without the usual flanges, which allowed them to negotiate

tighter curves without binding. In the LEGO world we have to deal with extremely tight curves so the use of blind drivers is usually a must. Blind drivers are typically placed in between sets of flanged drivers where the outside flanged drivers can still guide the locomotive around curves and produces the best running characteristics. However as you'll see in some of the photos presented in this article there are some very creative exceptions.

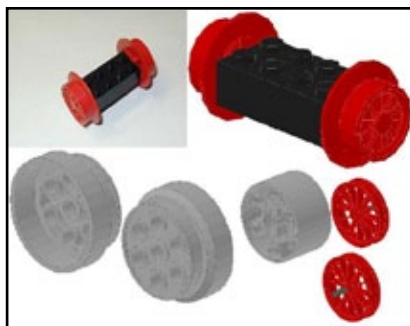
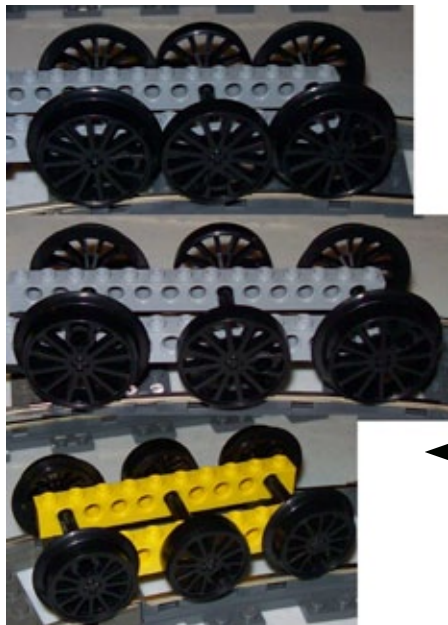
On real world steam engines the drivers are usually quartered where opposite sides of the engine are arranged 90 degrees out of phase with each other. This assures more even power delivery and assures the wheels are never at 'dead center' location when starting from rest. This is mainly an aesthetic detail for LEGO engines with not much affect on running performance but gives your engine added accuracy.



This Denver and Rio Grande Western Engine is based off a design by Steve Barile. The pilot wheels are rigidly attached to the locomotive and only the center pair of drivers is flanged. This results in the engine tracking as if it were an 0-8-0 instead of a 2-6-0.



Big Ben Bricks offers drivers large and medium sizes with flanged and blind options for each. Big Ben also offers small train wheels for use in pilot and trailing trucks.



▲ Some alternative wheel options for your steam engine.

▶ The top and middle photos show wheel spacing options for the large BBB drivers and the lower photo shows normal wheel spacing for the BBB medium drivers. Blind center drivers are used to help negotiate tight curves.

Drivers are one of the easier elements to build on your locomotive running gear. Once they're laid out they will set the tone for the rest of your locomotive. You'll have to do some experimenting to find what works best for your wheel arrangement of choice but that's what makes LEGO steam fun. And if your building an engine without a lead or trailing truck then your battle is almost over. Big Ben Bricks offers several more tips for using their drivers on their web site.

<http://www.bigbenbricks.com/applications.html>

With the drivers set up let's move on to the cylinders and drive and connecting rods. I've seen some LEGO steam engines out there

that lacked moving rods and to me this is just wrong. The motion of the piston and side rods is what makes steam so interesting. Leaving these elements out defeats the purpose of modeling steam.

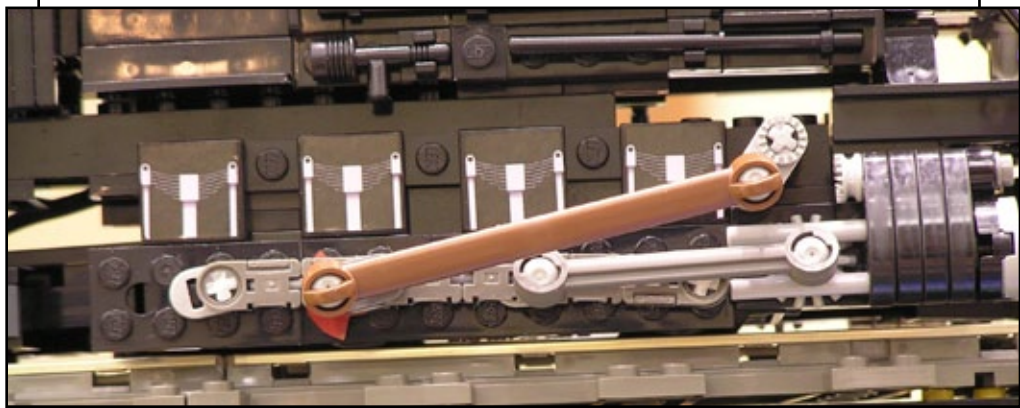
For the driving and connecting rods there are several options to choose from. The most popular option is to use the thin Technic lift arms. They come in various

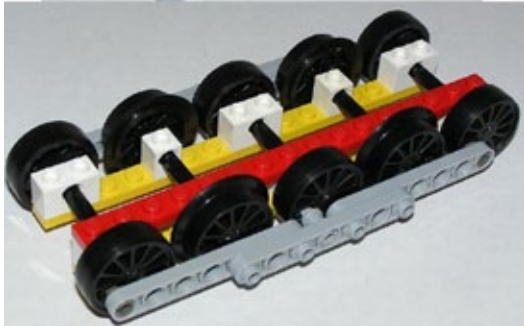
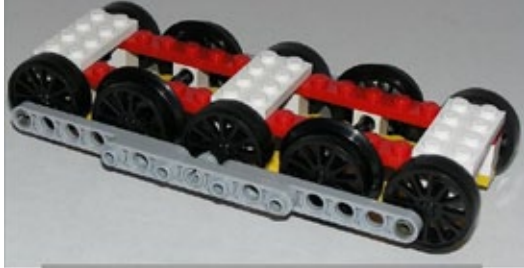
lengths and colors and are very versatile. While the holes running the length of the arms is a little un-prototypical their ease of use and versatility makes them my usual choice. Another option is Technic Flex Cables. These also come in various lengths and can be used to make very nice clean looking rods. The down side is that they are not very common and no longer produced by LEGO. Finding them on the second hand market can be a challenge. A third option is using Technic links with either ball joint or pin connections. These don't have the excess holes that the lift arms do but can be awkward to work with do to limited sizes and connection points. Cylinders and pistons can come in many designs. Big Ben Bricks offers instructions for a nice, simple and reliable cylinder design on their website.

http://www.bigbenbricks.com/040truck_withcylinders_instructions.pdf

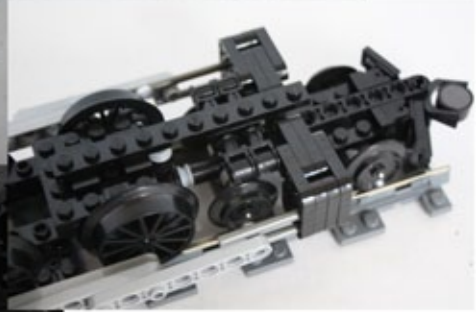
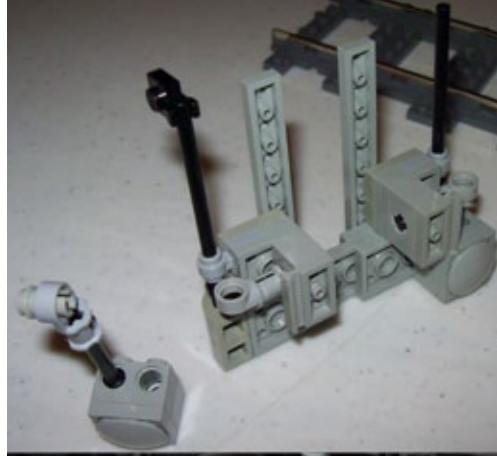
You can find instructions for cylinders of my own design in the second part of my PRR #7688 instructions also in this issue. The most important consideration when designing your cylinders is clearance with the wheels (especially important when using a pilot truck) and smooth operation.

This engine is not for the faint of heart. Brian Williams unique outside frame engine is described elsewhere in this issue. Here you can see his use of Technic Flex Cables and Links for side rods and he's even squeezed in valve gear.





BBB Medium drivers can be spaced closer together with the alternating use of 1x1 and 1x2 Technic Bricks.



The top cylinder design uses 3mm diameter Rigid Hose for the piston rods. The black Technic Pin filed out slightly on the inside to allow the tube to slide freely. The bottom design uses Light Saber Blades to guide the Technic 1/2 Pin. The stop on the 1/2 Pin keeps it from slipping out of the guide.

There is no single best design and you may need to experiment quite a bit to find what works for you and keep in mind that you may have to modify it some to fit in your pilot truck.

For those of you who really want to add some realism to your model you can also try modeling the valve gear (the mechanism that operates the inlet and exhaust valves to admit steam into the cylinder and allow exhaust steam to escape) of a steamer. Moving valve gear is not something I've personally implemented on my models yet. Most of the designs I've seen use modified parts (something I usually shy away from) and I've yet to come up with a design of my own that I'm happy with. All my engines so far have use a static representation of valve gear. Sometimes you just have to compromise.

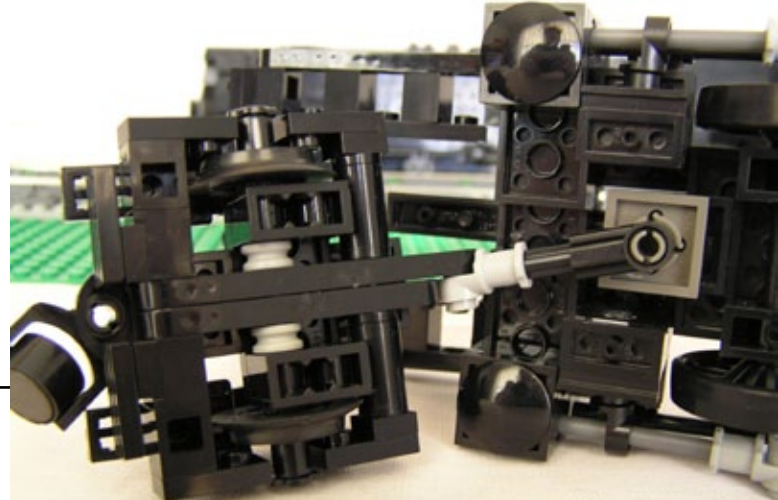


On his Norfolk & Western J Benn Coifman uses 9v train motors for the front and rear tucks and the design functions in the same manner as a diesel or train car. The drivers float freely from side to side to cope with curves.

Next up is the pilot or lead truck. The leading axle of a steam locomotive is an unpowered set of wheels or axles located in front of the driving wheels. The axle or



For their Hogwarts Express John and Ross Neal used blind pilot wheels rigidly mounted to the locomotive. This eliminates any clearance issues that a four wheel pilot would have around the cylinders.



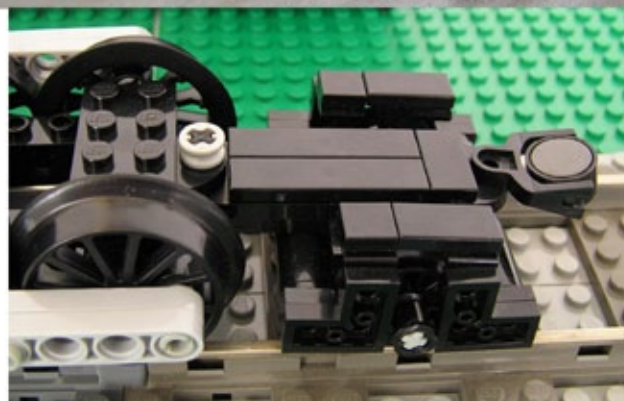
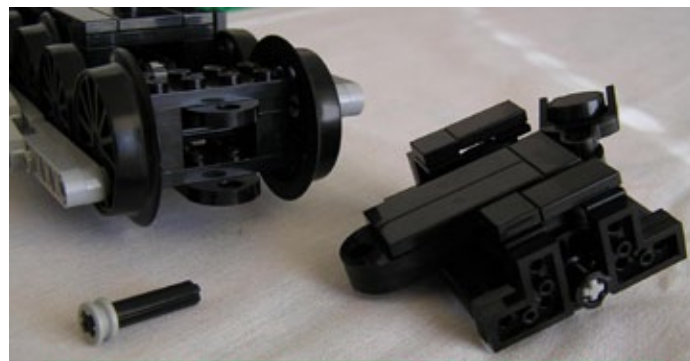
This 2 wheel pilot truck uses Big Ben's Small Train Wheels and is hinged to allow the truck to move up and down with track elevation changes.



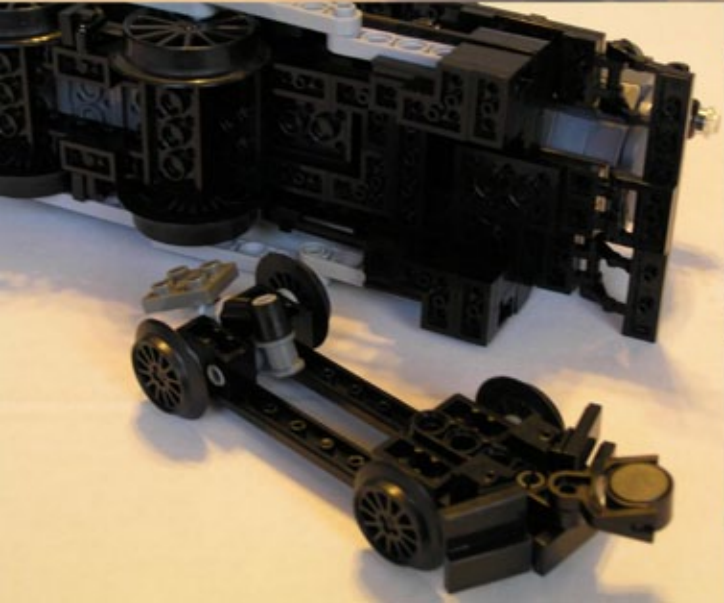
axles of the leading wheels are normally located in a lead truck (or bogie or pilot truck whichever term you prefer). Leading wheels are used to help the locomotive negotiate curves and to support the front portion of the boiler. On real locomotives the pilot truck can greatly improve the running characteristics of the engine. On LEGO steam ironically the pilot truck can be a source of trouble. This is because the truck has to clear the cylinders while negotiating LEGO's tight radius curves and do this while also dealing with changes in track elevation. That's quite a lot of stuff to worry about. Pilot trucks typically come in 2 and 4 wheel varieties. 2 wheel pilot trucks are the easier of the two to build. You only have one axle to worry about and only need one pivot point (the point on which the axle assembly rotates). The pivot point should be located as close to the front pair of drivers as possible for best running. Having a hinge so the assembly can move up and down with changes in track elevation will also improve running quality. 4 wheel pilot trucks are the tougher of the two. With



Benn Coifman uses the small LEGO train wheels with a single pivot point on the pilot truck for his Milwaukee Road Hiawatha. The first pair of drivers are blind so the engine can negotiate curves.



This trailing truck uses Big Ben Bricks small train wheels and allows for some up and down movement to help cope with uneven track.



This 4 wheel pilot uses tiles and an elongated wheel base to allow it to clear the cylinders.

4 wheel pilots usually one set of wheels is positioned in front of the cylinders and one pair behind. This can greatly complicate clearance issues. 4 wheel pilots also typically need two points of rotation to negotiate curves. The small LEGO train wheels can help with clearances but have a few down sides. They are sometimes too small in proportion to the locomotive and the plastic axles they use can cause squealing as the plastic wheel rotates on it. Big Ben's small wheels or standard LEGO train wheels without the frames can be used with careful design. Positioning the cylinders a little wider on the locomotive can also buy more room for the pilot wheels to move. And if all else fails you can always employ

blind pilot wheels such as John and Ross Neal have used on their Polar Express and Hogwarts Express. And having a hinge so the assembly can move up and down with changes in track elevation is also a good idea.

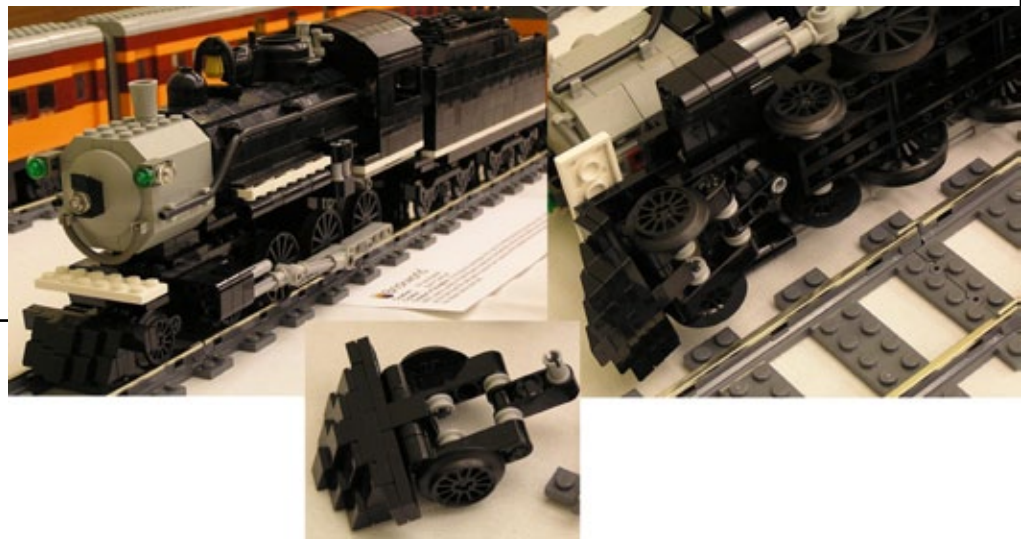
One aspect of pilot truck design some people may over look is weight. A heavier pilot will have fewer tendencies to jump off the track. Real railroads would sometimes add weight to the lead trucks of their engines to improve the tracking and this works equally well for LEGO steam.

The pilot truck could be the most challenging part of your locomotive to work out. As with all things LEGO steam it can often be a matter of trial and error but

don't give up. One of the great things about LEGO is that there is usually multiple solutions to a problem.

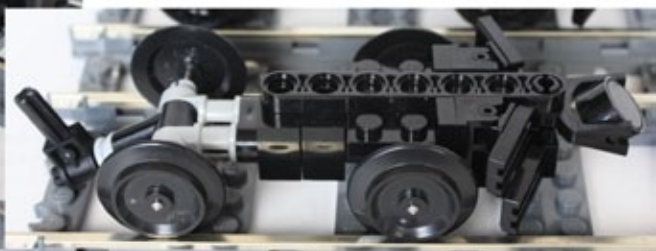
The last part of the running gear to work out is the trailing truck. On a steam locomotive a trailing axle is generally an unpowered set of wheels or axles located behind the driving wheels. The axle of the trailing wheels were usually located on a trailing truck. The main job of the trailing truck was to support the weight of the locomotive firebox. Depending on the weight of the engine you could have one, two or even three axles. The trailing truck is usually a simple build and shouldn't give you too much trouble. A com-

Benn Coifman designed this split truck solution for his Northern Pacific 4-6-0. The rear set of pilot wheels is rigidly attached to the locomotive and the first and second pair of drivers are blind. This design makes the engine track around turns as if it was a 2-8-0 eliminating clearance issues with the cylinders.



mon practice for four wheel trailing trucks is to use a 9v train motor as the truck. This can give you some added power in addition to any motors you may have in the tender. The trailing truck is also a convenient place to attach a coupler for your tender connection.

I hope you've found the tips and techniques in this article useful and hope you will continue reading. In the next issue we'll look at different boiler designs. 



This pilot uses standard LEGO train wheels without the frames. The design uses a single hinge point and the rear wheel set slides from side to side to negotiate curves. The cylinder design allows extra clearance for the larger wheels.

This Reading engine has no lead or trailing trucks to complicate things making this type of engine an easy build for a beginner.



The small LEGO train wheels can be used with an elevated cylinder design for extra clearance on a 4 wheel pilot. This pilot also uses to hinge points to allow it to follow curves.



BR23 Original Design by Reinhard "Ben" Beneke featuring BBB train wheels



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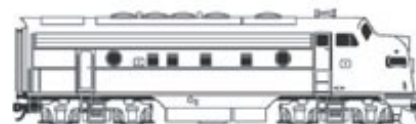


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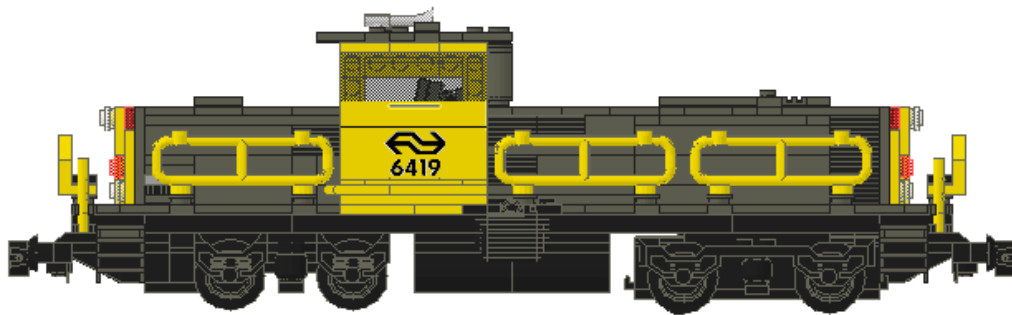
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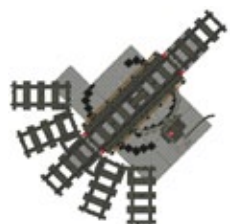
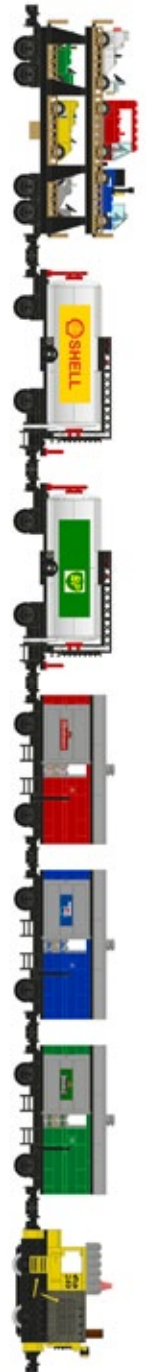
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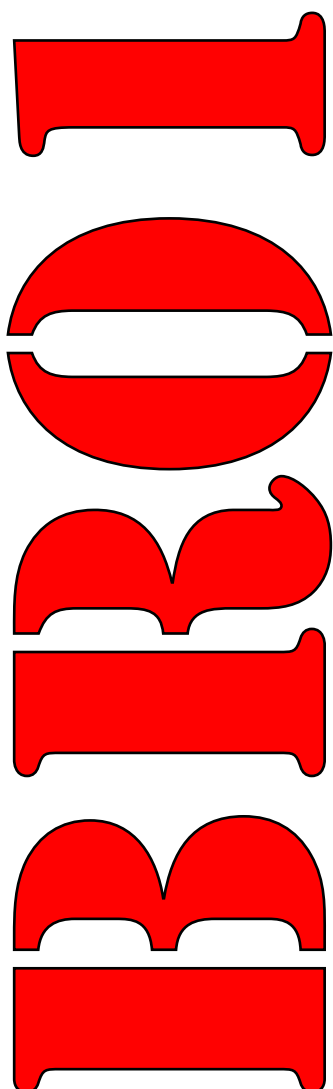


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The 01001, built in 1925



The 01 in LEGO by Uli Meyer

The BR01 was one of the first german **Einheitslokomotiven** (unified engines, BR ~ **Baureihe** ~ building series, 0 ~ express passenger). In the 19th century all german countries (like **Bayern**, **Preussen** etc.) had their individual railway structures including a large variety of engines. After world war I, there was the idea to unify the construction principles of future engines to make both manufacturing and maintenance more economic. For example the 01 had, like all engines for fast passenger trains, drivers of 2m diameter. This unification program was never realized in its full ambitious extent. Major reasons were the different demand caused by world war II, and thereafter the **Traktionswechsel** replacement of steam by diesel and electricity. Only few of the many constructions were build in large numbers. As a side effect of the program the **Einheitsloks** have this typical familiar look, that makes them interesting to be built in model. Finally some of the machines spent their last years in service in different european countries, as reparations for the lost war.

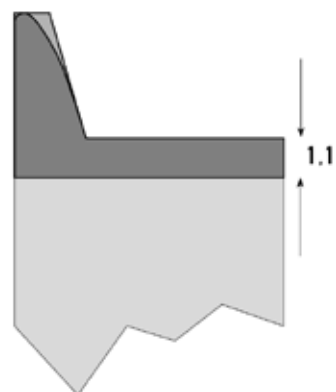
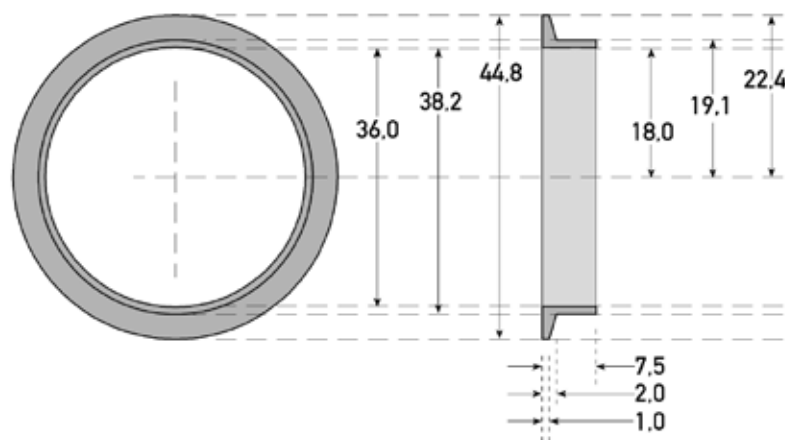
The 01 was found to be the superior design of a 4-6-2 (2'C1) engine in a competition between the 01 and the 02, and so 241 machines were built from 1925 on. The design was modified in several points, e.g. from 1939 on 55 engines had three instead of two cylinders. The fact that it was to heavy for many tracks, lead to the development of the similar 03. Most of the engines survived WW II and were reconstructed differently in both parts of Germany. They were in service until 1973 in western, until 1983 in eastern Germany. Today still a few BR01 are in operation pulling museum trains.

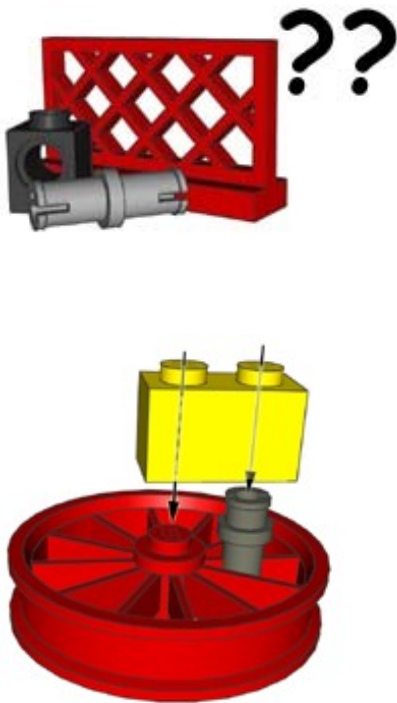


The red 70ies spoke wheels (LDRAW #35) as drivers result roughly in a correct scale. For my first experiments I removed the outer flange of the wheels, which requires some turnery, but I found the inner flange too small to hold the engine on the tracks when going through switches. So I supplied, like others did before, the wheels with appropriate aluminum rings. Probably you need somebody to do this for you, but with the sketch below it's not a big thing. Remember that the profile of the flanges must be rounded to make the wheels go well in curves. Just imagine a flanged driver intersecting a curved rail!

Then I had the idea of driving these wheels by an 70ies train motor. Experiments with a 4,5V motor were successful, but it required more power to pull a heavy engine with wagons. Finally I found a solution (see below) that makes use of the wise design of the old motor. You can run it on 9V with infra-red control. The coal tender has enough space to hold eight rechargeable AA-size NiMh batteries ($8 \times 1,2V = 9,6V$).

Now that there were already so many custom made things, I decided to have moving rods. This required one of the three drivers to be blind (no flange). The blind drivers don't touch the rails, they need to be driven by the rods. Therefore it is necessary, that the left and right connecting rods have an fixed angular displacement of 90° – like the real engine! Unfortunately the short brass axles of the spoke wheels can slip in the bush of the motor. Due to friction in curves – remember that we usually run in a circle, either left or right – the angular displacement becomes 0° or 180° by the time: the mechanism will stick and fail!





One could solve the problem by gluing the brass axles into the bushes that are fixed to the gear (wheels could still be removed by unscrewing the motor). I preferred to fix the angular displacement at the blind drivers by replacing the two short axles by one longer brass axle. I drilled an appropriate hole in a 2x4 brick to support this axle. Additionally I allowed the motorized wheels to slip on the rails by removing the rubber rings I used before.

Now I had to fix technic pins to the spoke wheels. I enlarged (cut) the already existing slits of the pins, so they fit loosely on a spoke. Next I fixed the pins exactly using a temporary LEGO construction mount to the center stud of the wheel as reference. Unfortunately I forgot how it worked exactly, but I remember that it required a fence brick to achieve the correct depth, so the rods won't hang on the center stud when in motion. Once all pins were mount in a one-stud-radius (8mm) as indicated by the yellow brick, I glued this by filling two-component adhesive between the hollow pin and the spoke from behind.

At this point you could take technic liftarms as rods. For three reasons I decided to mill customized rods: (1) it simply looks better (2) the gauge of LEGO rails is always too large and technic liftarms will increase this misproportion (3) it allows to model the Heusinger-Walschaerts-control that looks very funny when in motion. Once again I took advantage of the principle to use the exactness of LEGO parts if you are going to make customized parts. The rods are milled from PE (polyethylene, elastic!). There was no gluing required. Holes of 4.5mm will stick on pins. 4.8mm holes will turn freely. For the small control rods I used white PS (polystyrene) tubes of 3.2mm diameter as axles. With some turnery I made them either stick or turn freely, like a miniature version of technic pins. On the other hand a 3.2mm tube, holds, like the flex tubes, in a hollow stud!

How to repair and modify 70ies train motors

The 70ies train motor was the only one intended to be opened. It had screws! Exchange motors were available. Both the 4.5V and the 12V motors fit into the same gear box, but used different transmission ratios. The 12V version is comparable in power and speed and compatible to the 80ies train motor.

After 40 years in service most of the motors are in bad condition, and it is hard to get good spare parts. Usually the gear itself still works fine. Here you find instructions how to find cheap exchange for the powerful Bühler motors, and how to use the slow transmission ratio to compensate for the large diameter of the spoke wheels used on my BR01.

The modification makes my heavy engine run at an acceptable speed and power even if run at only 9V.

If you want to do the modification for small old train wheels (fast transmission ratio) it is only a little more difficult. CONRAD has a transparent 10mm silicone tube on stock that makes perfect long-life rubber rings for the old red train wheels!

It takes about one hour and requires only little tools but be aware that you might destroy an precious vintage part, harm yourself etc.

So I take no responsibility if you follow my instructions and I ask you not to do it, if you don't have appropriate tools and craftsmanship.

ulimy@freenet.de
(C)2009 Uli Meyer
Germany



Open the casing by unscrewing the two upper screws



The Bühler 4.5V motor drives the left (smaller) gearwheel. Alternatively the 12V motor drives the right (larger) gearwheel. Due to the design of the gear the 12V engine runs much faster. The idea is now to replace an old 4.5V motor by a new strong 12V motor but to use the lower (4.5V) transmission ratio to make it useful to run with large spoke wheels!



This one is available at CONRAD electronic for €5.



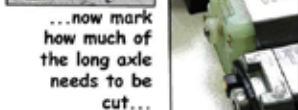
Two make the new motor fit, we need to (1) mill the gap at the bottom that holds the motor on the gear (see left) (2) cut the axles (3) transfer the brass gearwheel and (4) fix the electric contacts.



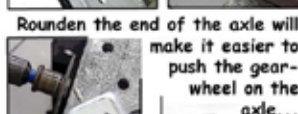
Remove the brass gearwheel. Do not spoil the wheel by grasping the teeth, but shift it off the axle from below



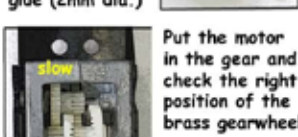
Next mark the gap to be milled at the printed side (engraving SUN) for correct polarity lateron



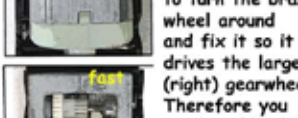
Now cut the short axle. Caution it might get hot! Remove heat by fixing some metal to the axle...



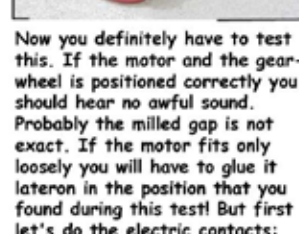
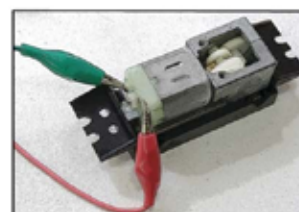
Now mill the marked gap. Work like a dentist, step by step, until it fits into the gear...



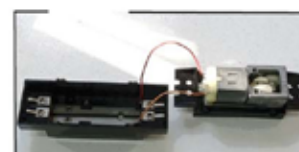
...now mark how much of the long axle needs to be cut...



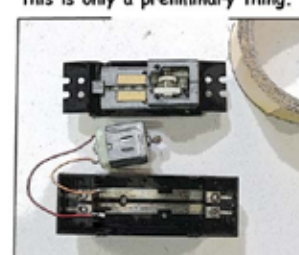
Rounden the end of the axle will make it easier to push the gear-wheel on the axle...



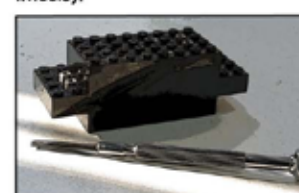
Now you definitely have to test this. If the motor and the gear-wheel is positioned correctly you should hear no awful sound. Probably the milled gap is not exact. If the motor fits only loosely you will have to glue it lateron in the position that you found during this test! But first let's do the electric contacts:



The Bühler motor contacts the tin plates inside the casing directly. We have to solder two small wires between the tin plates and the contacts of the motor.



Now repeat the test and glue the motor to the gear in the tested position. You can try with double-sided adhesive tape, but this is only a preliminary thing.



I recommend Cyanacrylate as adhesive. It sticks fast and does not hold too strong, so you will be able to separate if necessary. Be careful not to spill any glue into the lower part of the gear (the little gearwheels that transmit between the front and rear wheels).



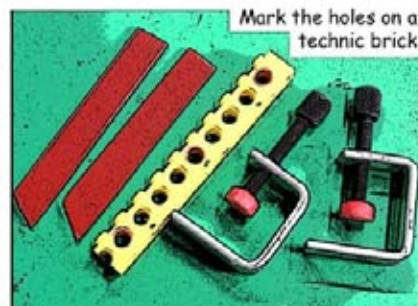
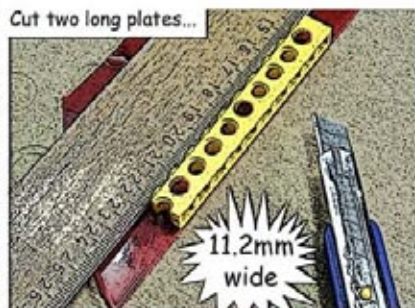
Now close the casing again. If the wires are not too long it should be possible to close the casing without violence. Good luck

How to mill CUSTOMIZED RODS for BB-wheels.... from a piece of plastic trash

This is PE (polyethylen, swims on water)
PROs: cheap, common, quite elastic
CONs: melts easy, difficult to glue

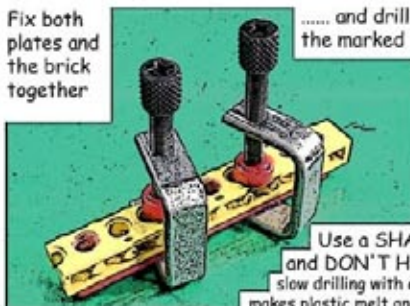


Cut two long plates...



Mark the holes on a
technic brick

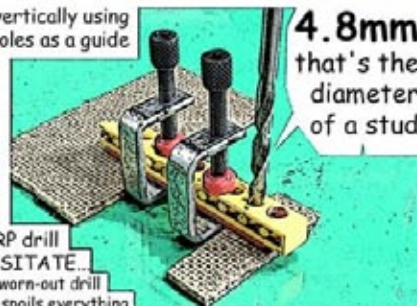
Fix both
plates and
the brick
together



..... and drill vertically using
the marked holes as a guide

Use a SHARP drill
and DON'T HESITATE...
slow drilling with a worn-out drill
makes plastic melt and spoils everything

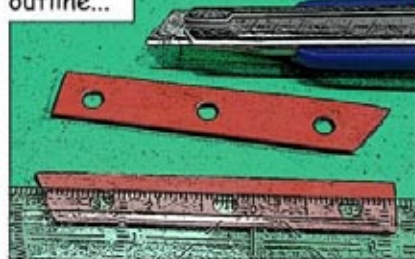
4.8mm
that's the
diameter
of a stud



Cut eventual burrs
with a sharp knife



Mark the
outline...

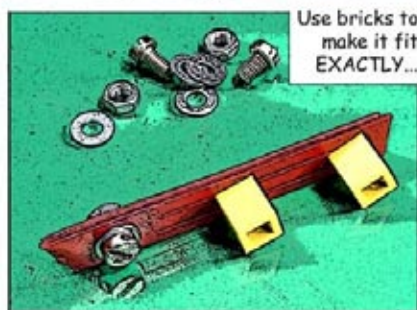


Screws and
nuts to hold
both plates
together...

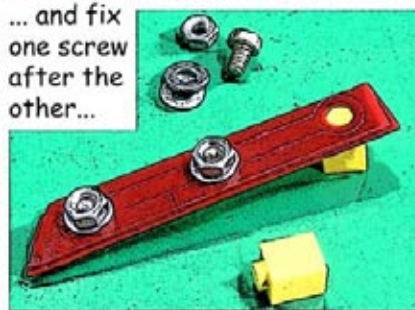


the discs on the screws will protect the round outline

Use bricks to
make it fit
EXACTLY...



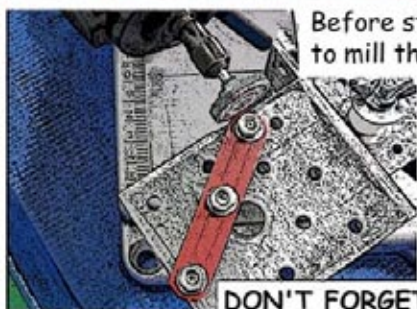
... and fix
one screw
after the
other...



Cut EXTRA
MATERIAL



Before starting
to mill the rods ...

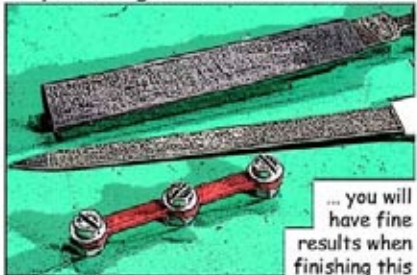


Mill at LOW speed.
HIGH RPM causes
plastic to MELT.
Remove burrs of
molten material
from time to time
using fingernails



...and work
SLOWLY!

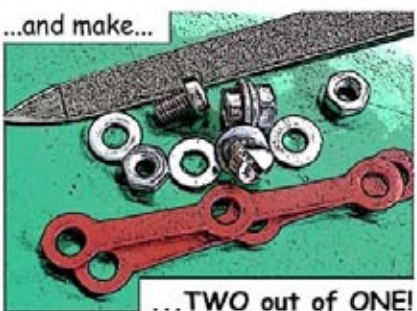
If you are good in MANICURE.....



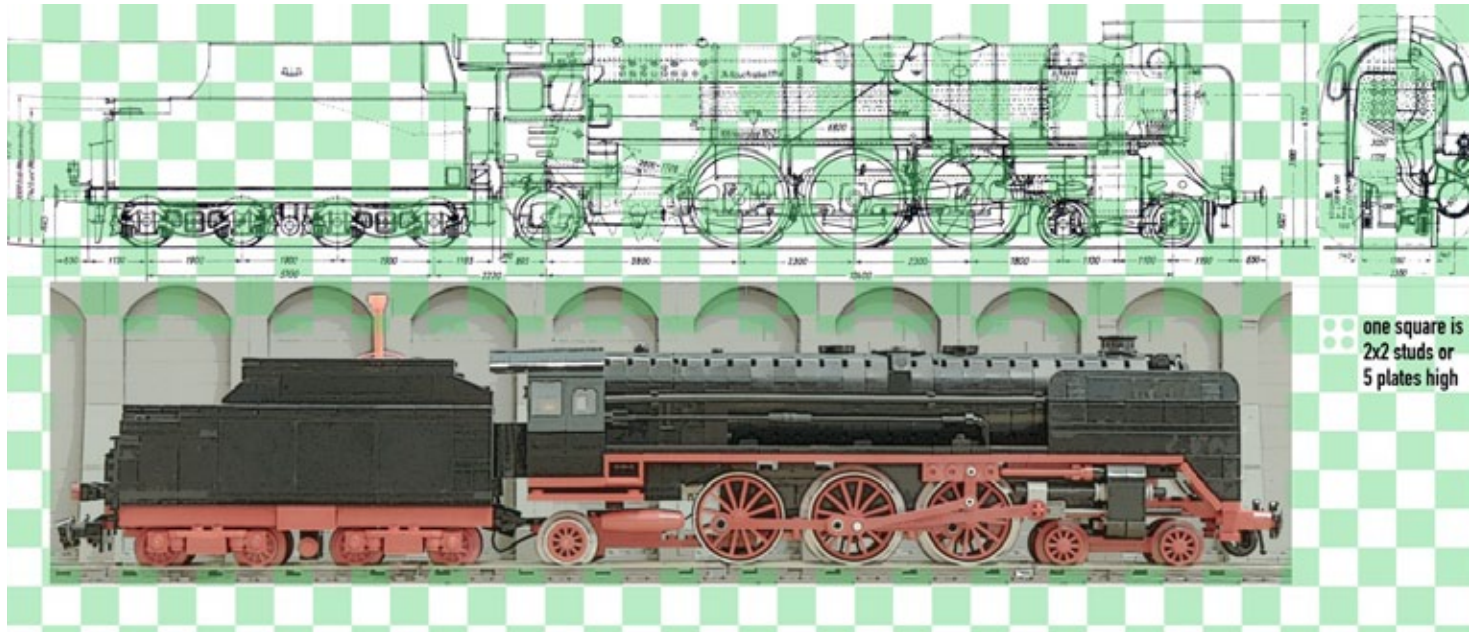
... you will
have fine
results when
finishing this



Remove the screws...



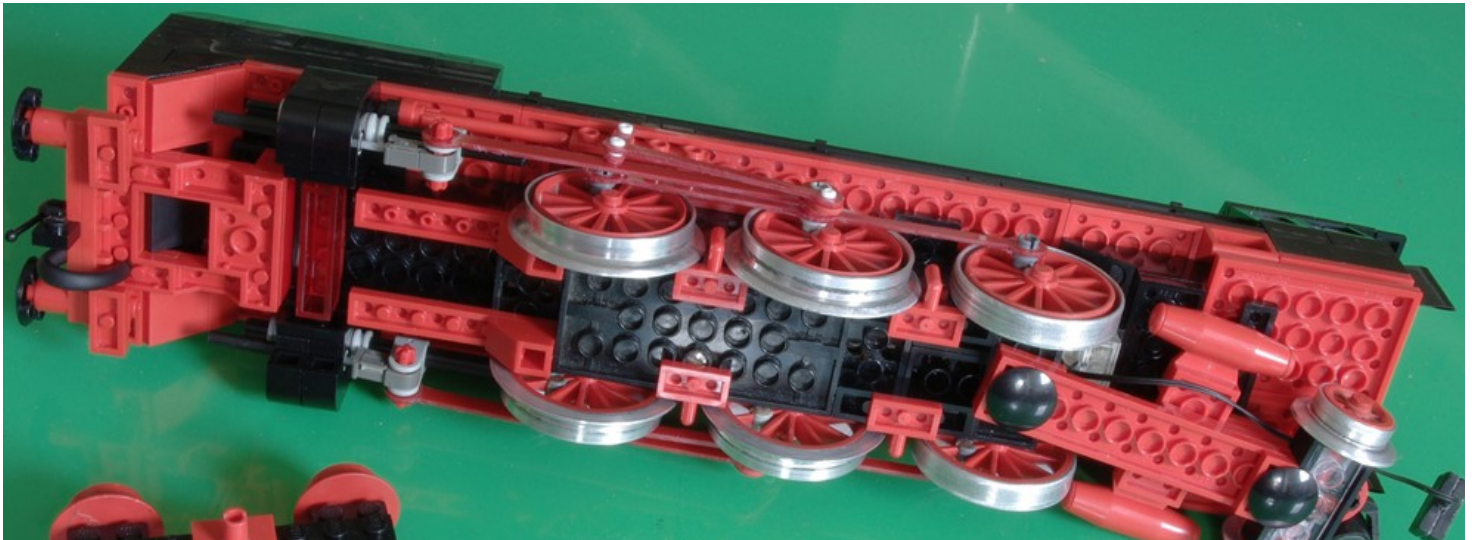
...TWO out of ONE!

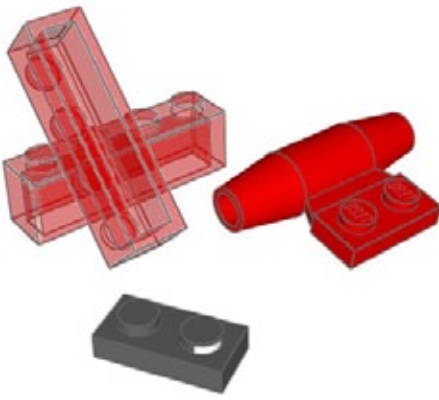


When scaling the 2300mm between adjacent drivers from the original construction sketch to the 48mm (6 studs) of the model, we get a scale of 1:48. This makes a minifig being 190cm tall in reality, the LEGO engine 500mm long (62 studs or almost four straight tracks) compared to the original length of 23940mm. If you use smaller drivers (like large BB-wheels) minifigs will be giants! So I used the above LEGO raster scaled to the original sketch as a rough guide when modelling the engine.

Let's have a look at the frontal profile: 8 studs wide is perfect. However, the gauge of rails **Spurweite** in Germany is 1435mm, makes 3.7 studs. The gauge of LEGO rails is roughly 4.5 studs – an error of more than 20%. This error makes all LEGO engines and wagons look wrong proportioned, and very difficult to build realistic wheel assemblies, especially if you consider the very narrow curve radius. This is also the main reason, why I decided to mill customized rods that are less than 2mm thick.

The narrow curve radius required a lot of experimenting to finish the gear. To maximize the clearance of the four front wheels at the cylinders, these are supported loosely inside a 1x4 brick without centre studs #3066.





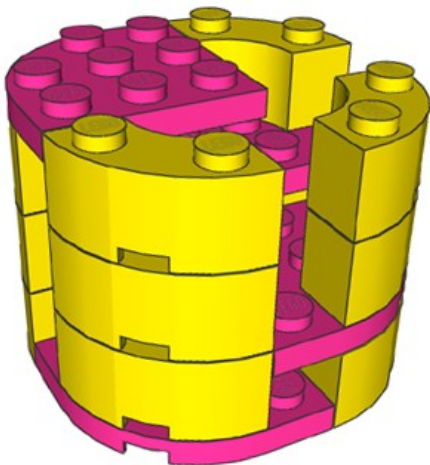
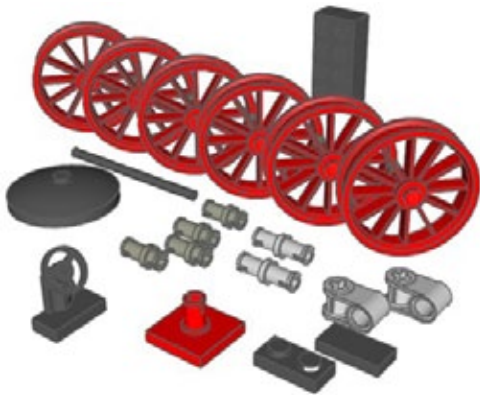
The aft wheel pair is linked to the main gear just below the blind wheels. This way the link (with the -non-realistic- mount red jet engines) has just enough clearance in curves and the aft axle is only little crooked to the rails. The link also supports the magnet coupling to the coal tender and the power supply cable. As LEGO cables are quite stiff, I soldered a thin cable to an Electric Plate 1x2 with Contacts #4755. This way the tender can be uncoupled very quickly.

The plugs that close the holes of the jet engines are made from broken pieces out of my trash box. It requires a little turnery but they can be made from all parts that have hollow studs.

It is difficult to close the 2-stud gap between the locomotive and its tender. Both vehicles move extremely relative to each other when entering or leaving curves. The real engine has small doors and ladders for access to the control cabin. I found a cheap five-minute solution to fake the doors by using black plastic sticker foil. I folded the foil in half on the adhesive side. The overlapping rectangle sticks at the inside of the cabin. When entering the curve the *soft* door touches the tender for a millisecond and flips back thereafter.

All these measures make the engine run at 0.35m/s when pulling two long passenger wagons on an average track (2/5 curves 3/5 straight) at 9V. That's about half the speed of the original (120km/h). Almost all of the weight of the locomotive is carried by the motorized drivers. As a result of this it lurches a little from side to side in the rhythm of the moving rods, which - by the way - make a lot of noise..... heart-beat! Isn't that what fascinates us about steamers? Dirty, heavy, powerful, noisy, visible, self-explanatory mechanics!





One might have the impression I have great fun in destroying parts instead of using them. On the left you see the few parts I modified besides the motor. I combined the pins with the spoke wheels, and drilled a 2x4 brick for the blind wheel axle. I cut the middle part of the #6536 axle joiners to improve the functionality of the pistons. I drilled a 3.2mm hole in the centre stud of the 4x4 dish, and fixed the little steering wheel there with a short piece of flex hose. The remaining stand of the steering wheel I used elsewhere. I had to file the pin of the red 2x2 tile a little to make it move more freely. And I soldered this customized electric brick with wire. Finally I cut two short pieces of rubber hose.


Non-LEGO-parts are the exchange motor, the aluminum rings, a brass axle of 3mm diameter, some cable, black sticker foil for the doors, white sticker foil for the ring-like markings on the buffers, the ten rods, some polystyrene-tubes of 3.2mm and 4.8mm diameter (for *double-studs*, that hold the red #2432 handle upside down).

The 5-wide boiler is made from 81 #3063 macaronis. If you don't want to spoil the almost-round profile, you need to fix it with overlapping #30357 round corner plates. I had to build it almost massive and it finally required only nine corner plates to stabilize it. Although this is basic bricking, it can be very challenging because old macaronis don't hold well, if at all, and filling the gaps between the round parts in a both stable and economic way is a labyrinthian task. Finally the engine weighs 1050g including batteries. When applying the 1:48 scale raised to the third power this is only 116tons compared to the 170tons of the original 01.



LEGO trains started in the 60ies with battery power and presently it looks like it will end with battery power. The first remote control for trains were sets 138, 139 and 139A from 1969!

I personally don't understand, why the most important LEGO principle – modularity – had been mistreated so often in the past train programs. By the way – modularity was also the main principle of the **Einheitslokomotiven**... and they didn't really manage it either!

So I am waiting for suitable remote control for motors and switches, and at least another curve radius. 

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Building a Power Function Steam Engine **Part 2**

by Cale Leiphart

For #7688's running gear I had two main goals in mind. The first one was to stay as true to the actual prototype as possible. I am a detail nut after all. Second I wanted to make the construction modular to help ease construction and to make it easier for other builders to modify the design to suit their own needs. The frame and running gear presented here serve this idea well. The running gear is independent of the boiler and cab and the design could easily be adapted to any number of 2-8-0 steam locomotives.


Since the side rods don't actually connect all pairs of drivers this design uses gears between the second and third pair to keep all drivers in sync. These gears if desired could be connected to a Power Functions motor so that the locomotive is powered through the drivers. For the #7688 I decided against this so that I could keep the engine construction simpler and also more aesthetically pleasing. The tender drive presented in the previous issue works well enough for me and was much easier to hide.

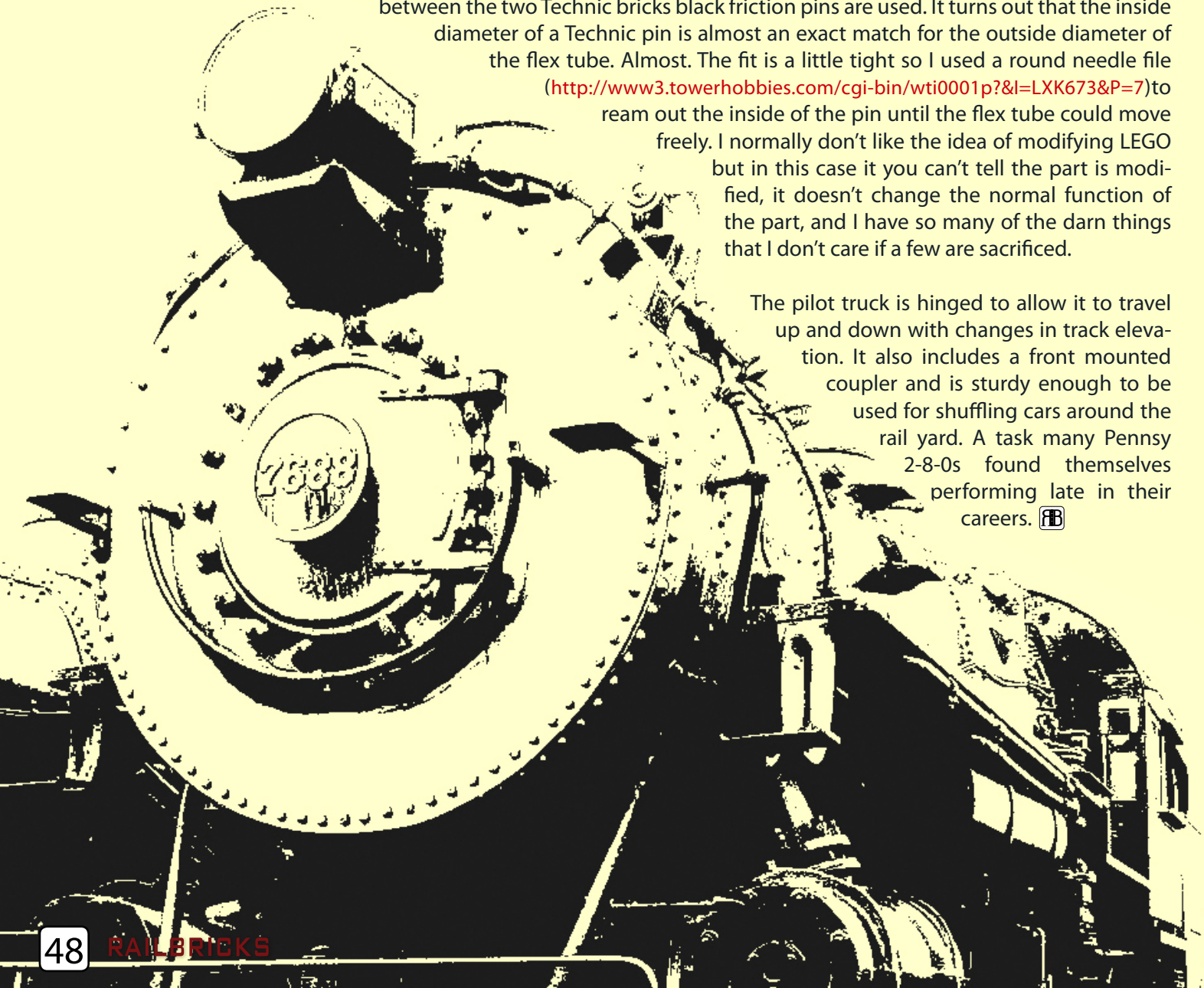
A word of warning for you builders out there who shun modified LEGO. The cylinder design requires the modification of two Technic pins. The piston rods are 3mm diameter rigid hose cut to 1 ½ inches in length. The normal opening in the Technic bricks is large to properly seat the piston rods without excessive play. To minimize this and to eliminate the ridge

between the two Technic bricks black friction pins are used. It turns out that the inside diameter of a Technic pin is almost an exact match for the outside diameter of the flex tube. Almost. The fit is a little tight so I used a round needle file

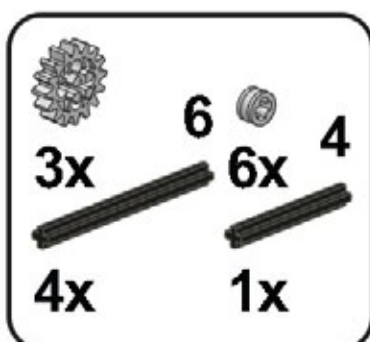
(<http://www3.towerhobbies.com/cgi-bin/wti0001p?&l=LXK673&P=7>) to ream out the inside of the pin until the flex tube could move freely. I normally don't like the idea of modifying LEGO

but in this case it you can't tell the part is modified, it doesn't change the normal function of the part, and I have so many of the darn things that I don't care if a few are sacrificed.

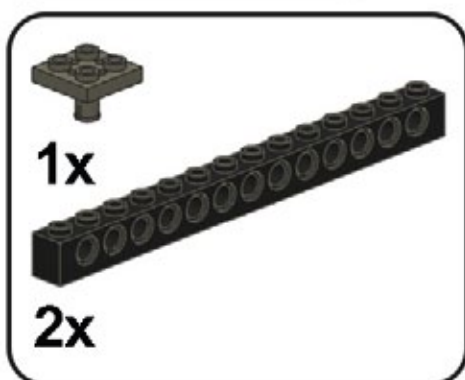
The pilot truck is hinged to allow it to travel up and down with changes in track elevation. It also includes a front mounted coupler and is sturdy enough to be used for shuffling cars around the rail yard. A task many Pennsy 2-8-0s found themselves performing late in their careers. 



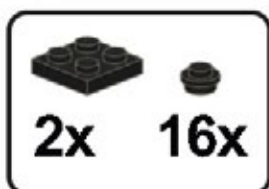
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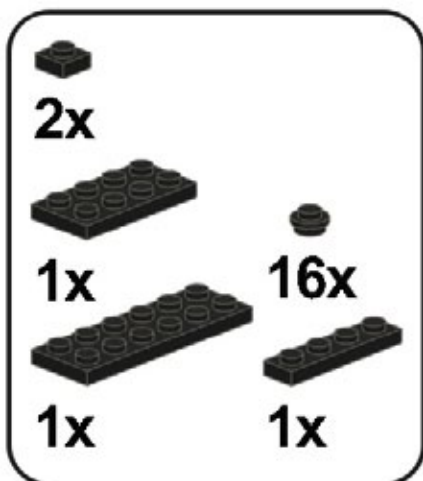
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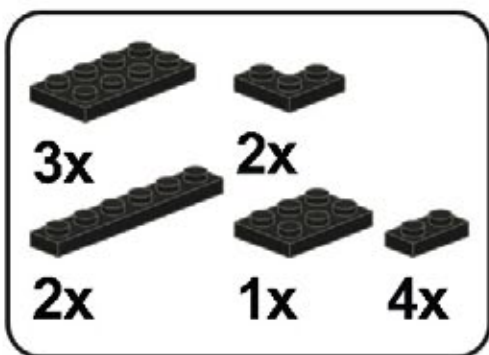
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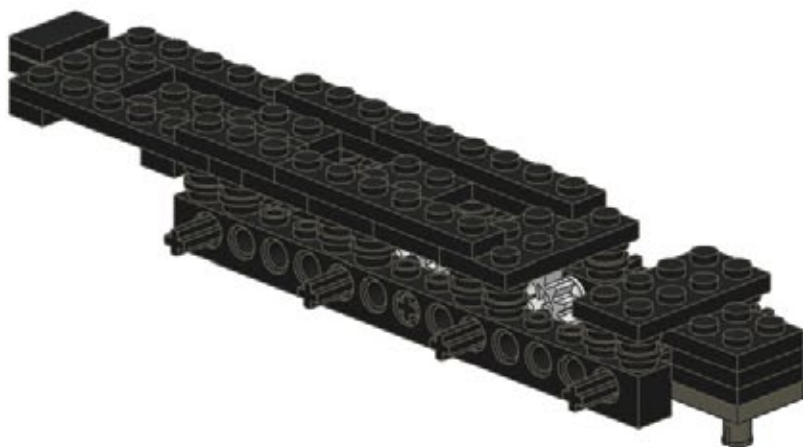
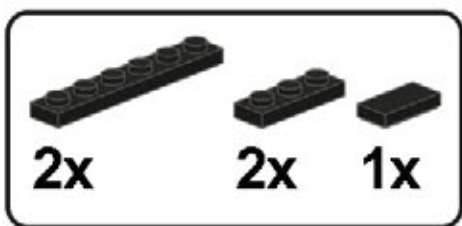
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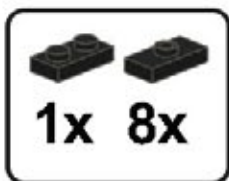
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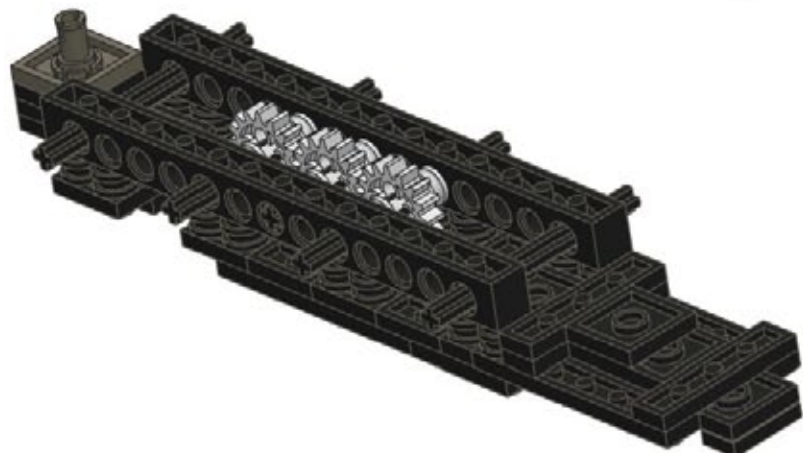
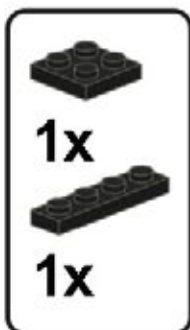
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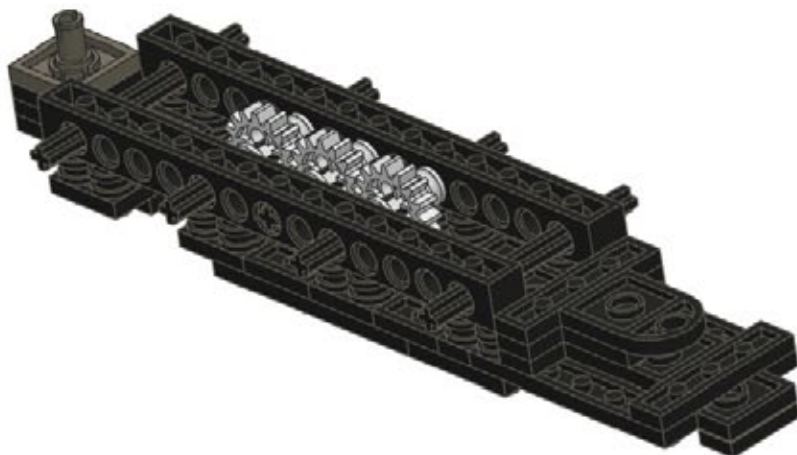
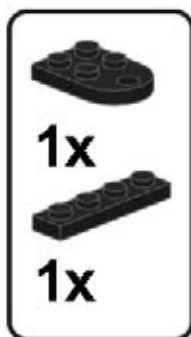
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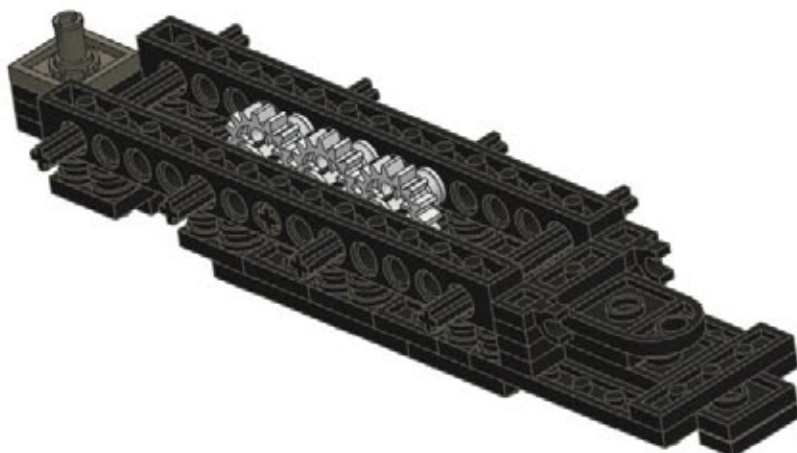
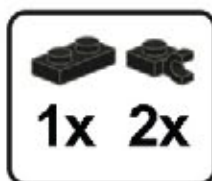
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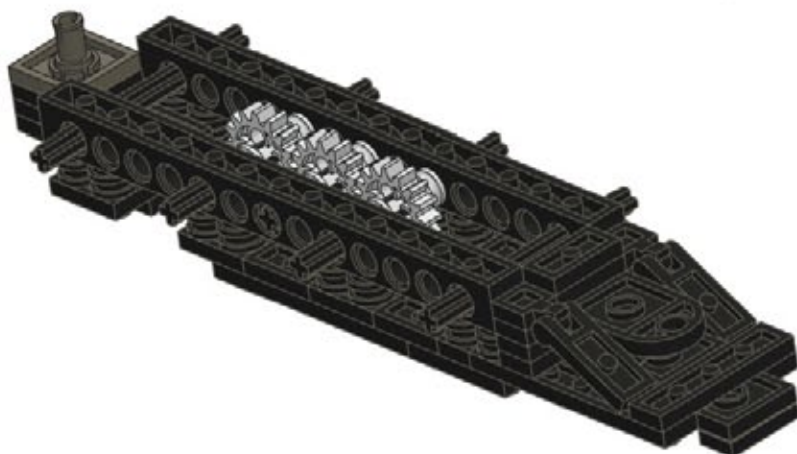
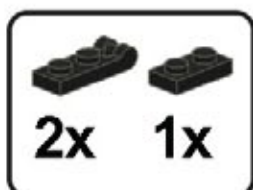
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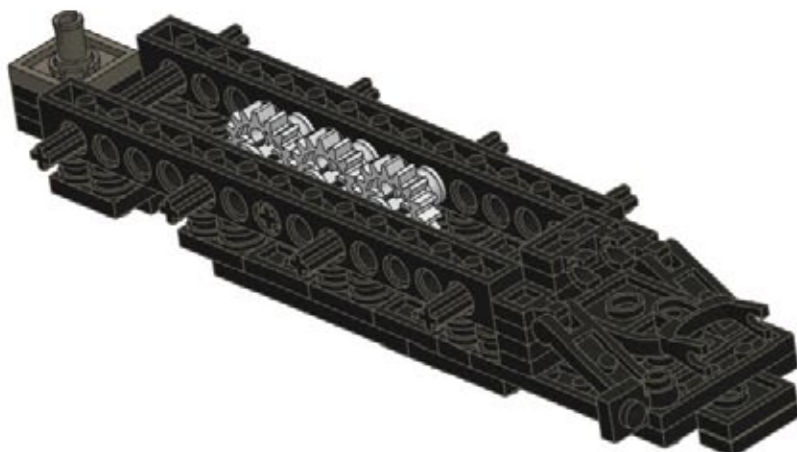
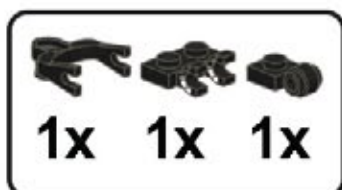
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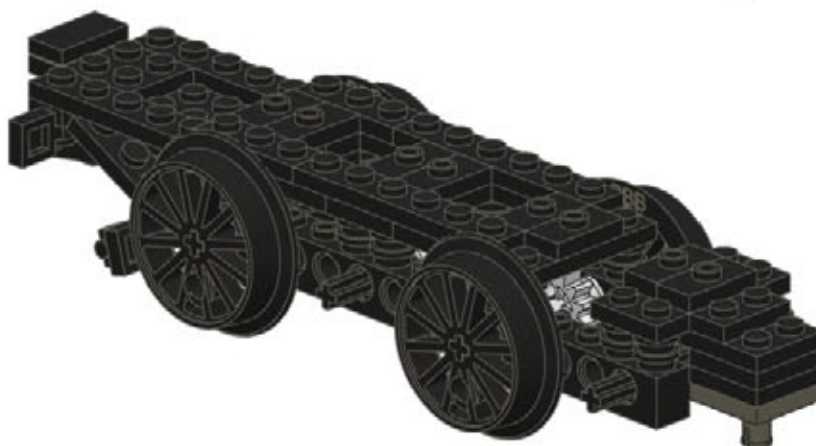
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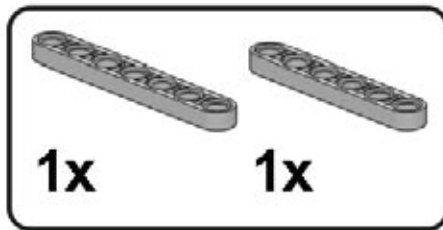
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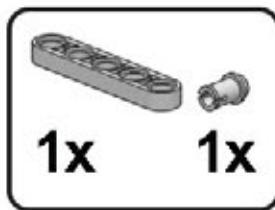
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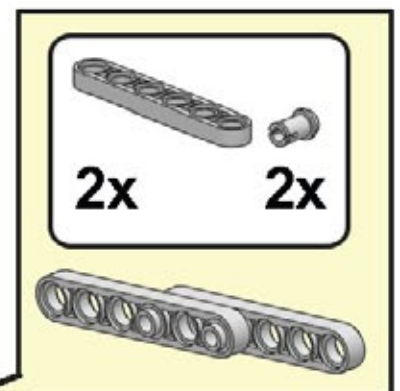
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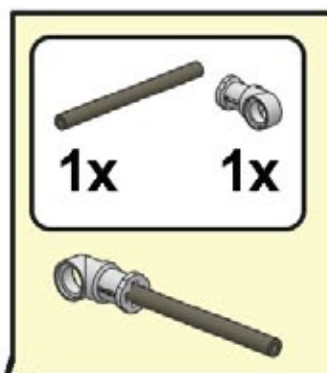
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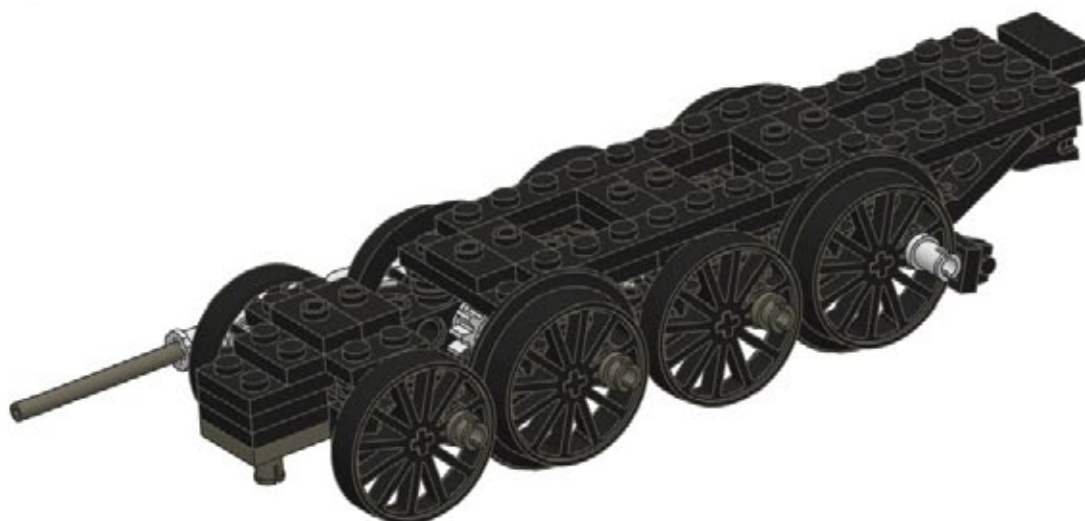
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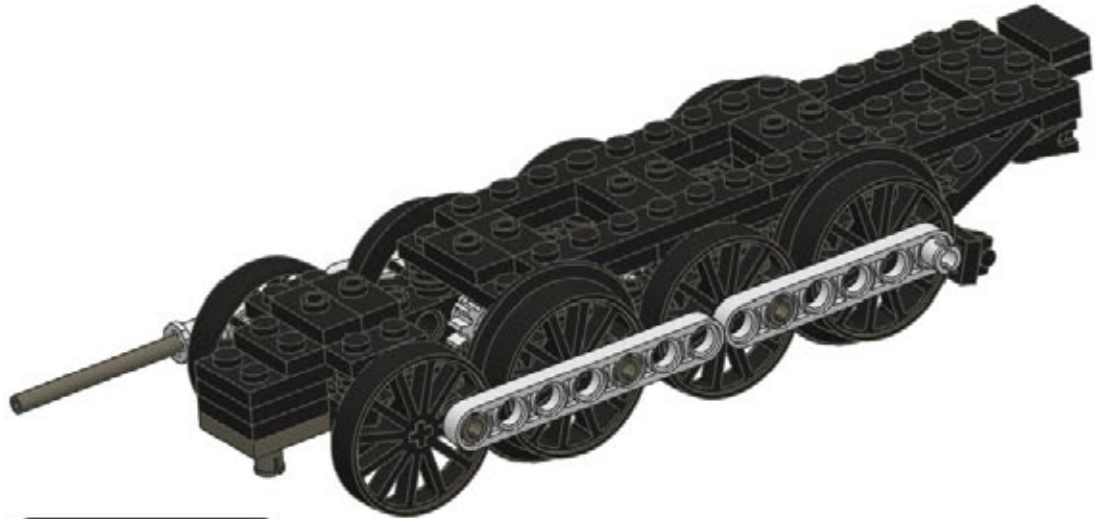
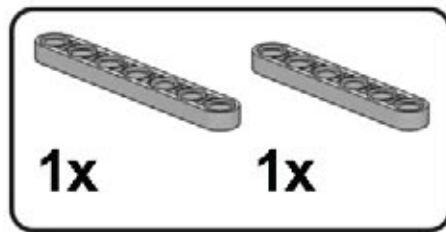
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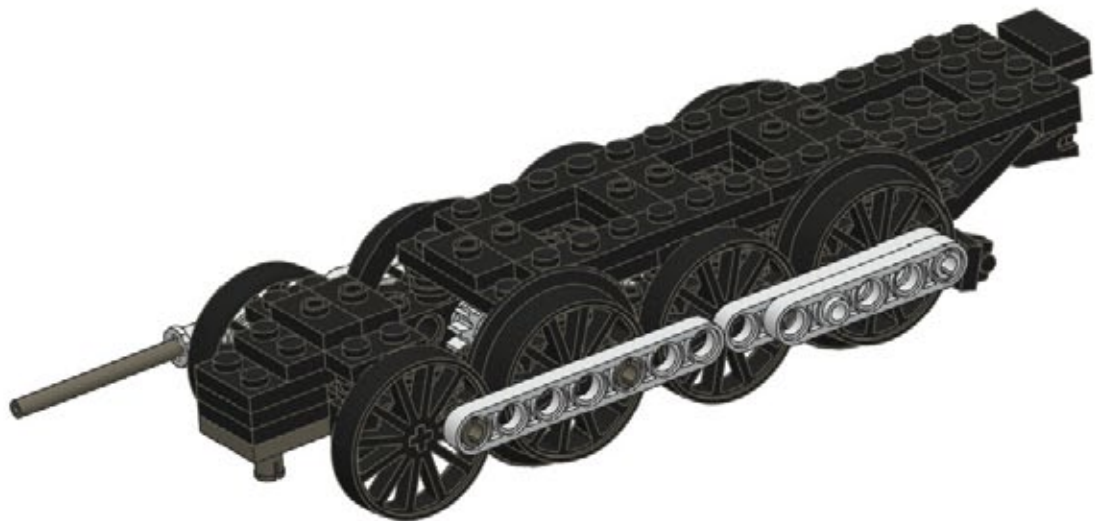
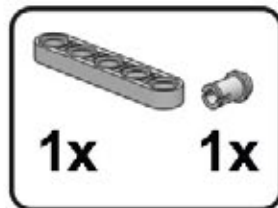
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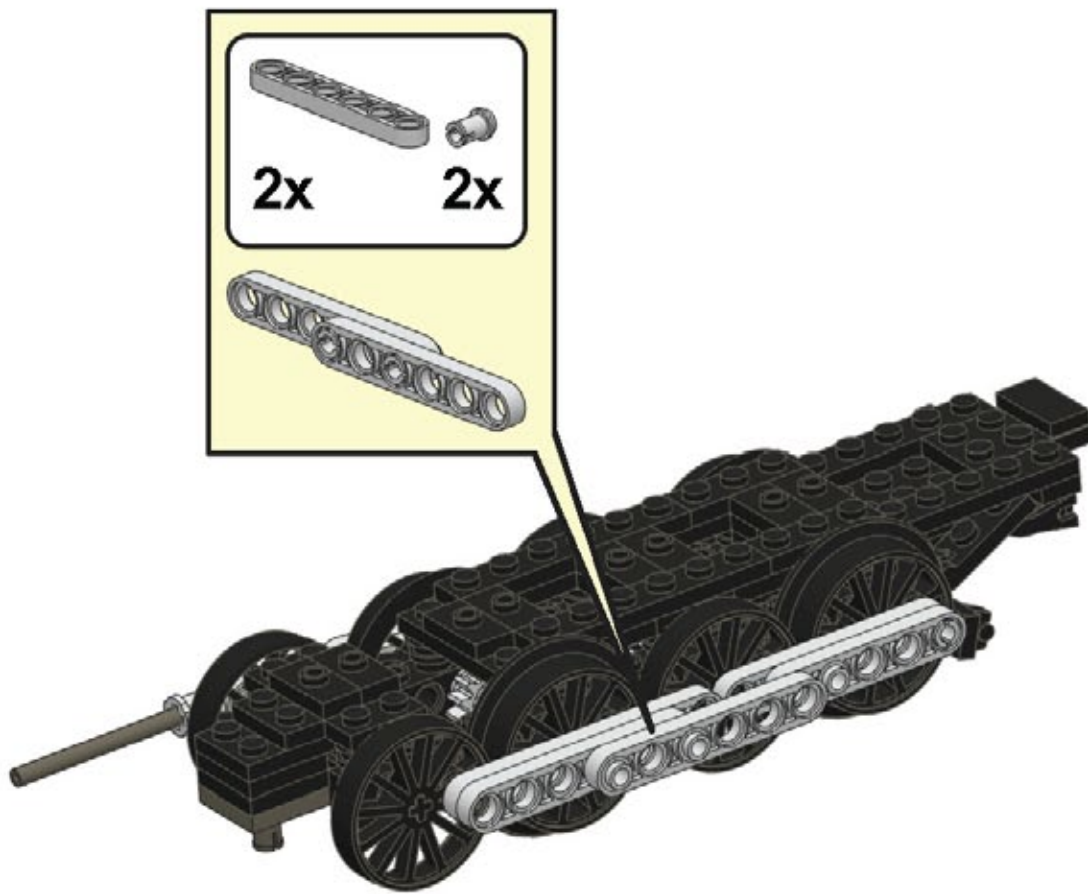
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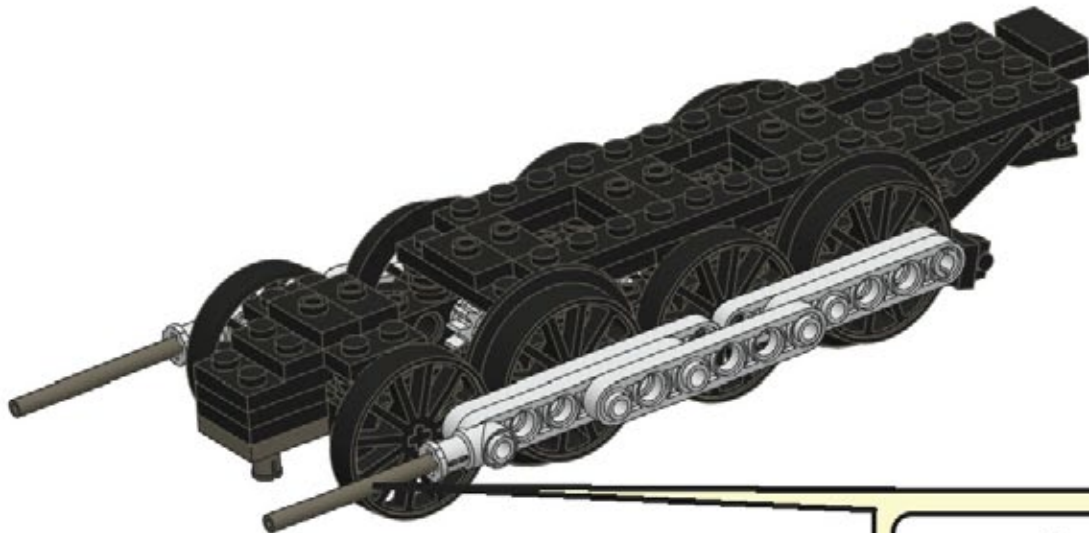
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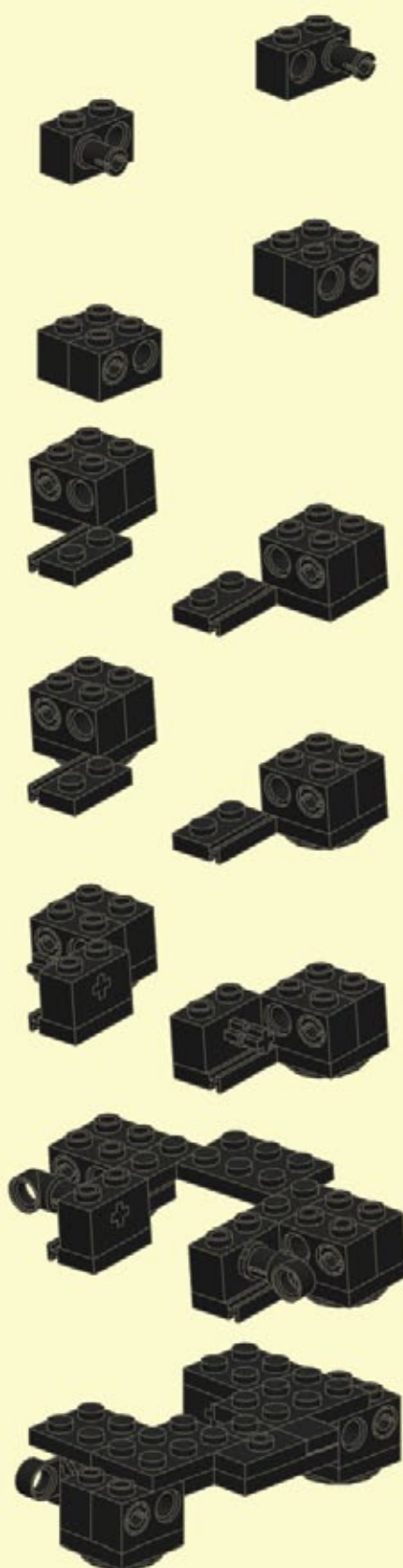
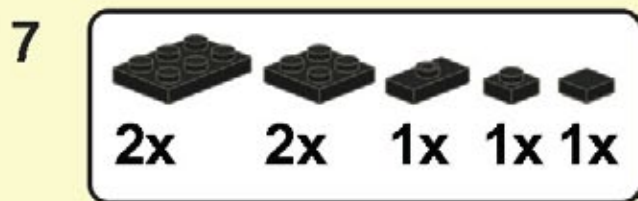
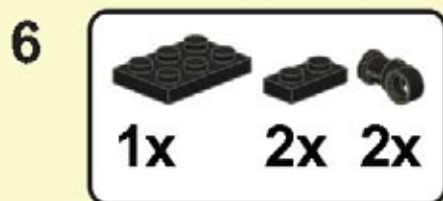


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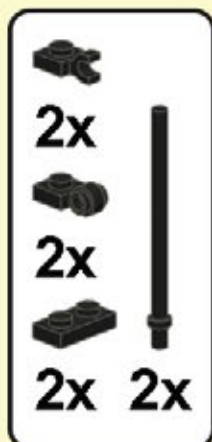


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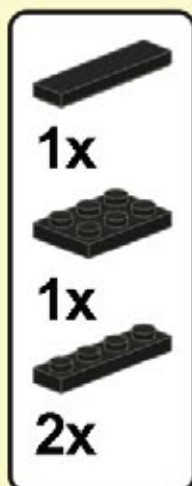




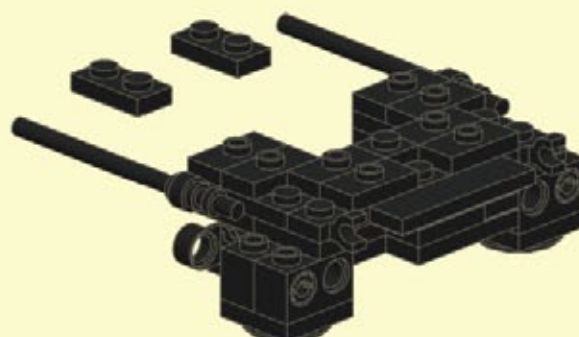
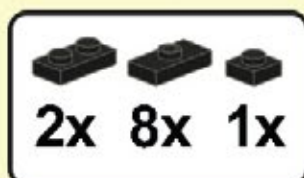
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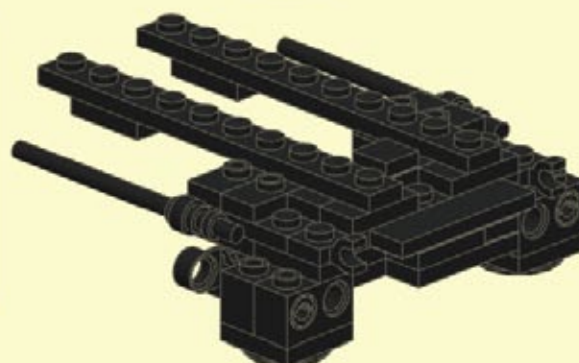
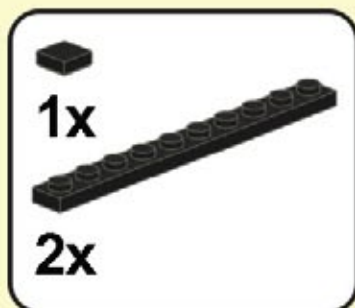
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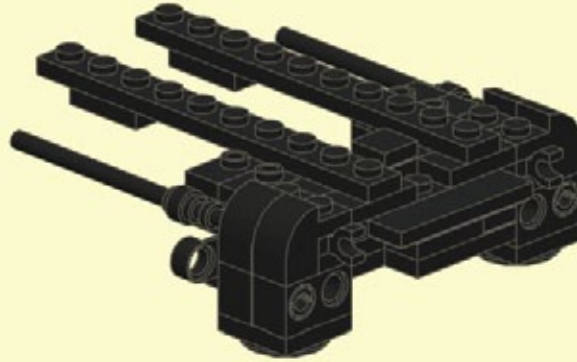
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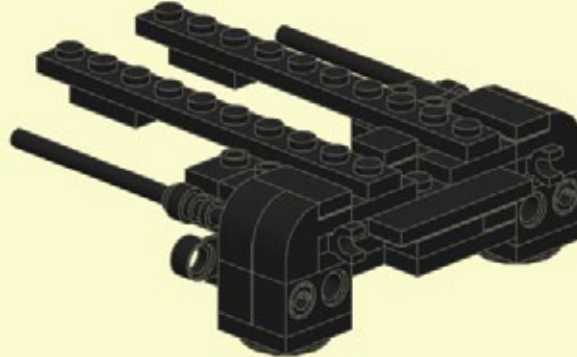
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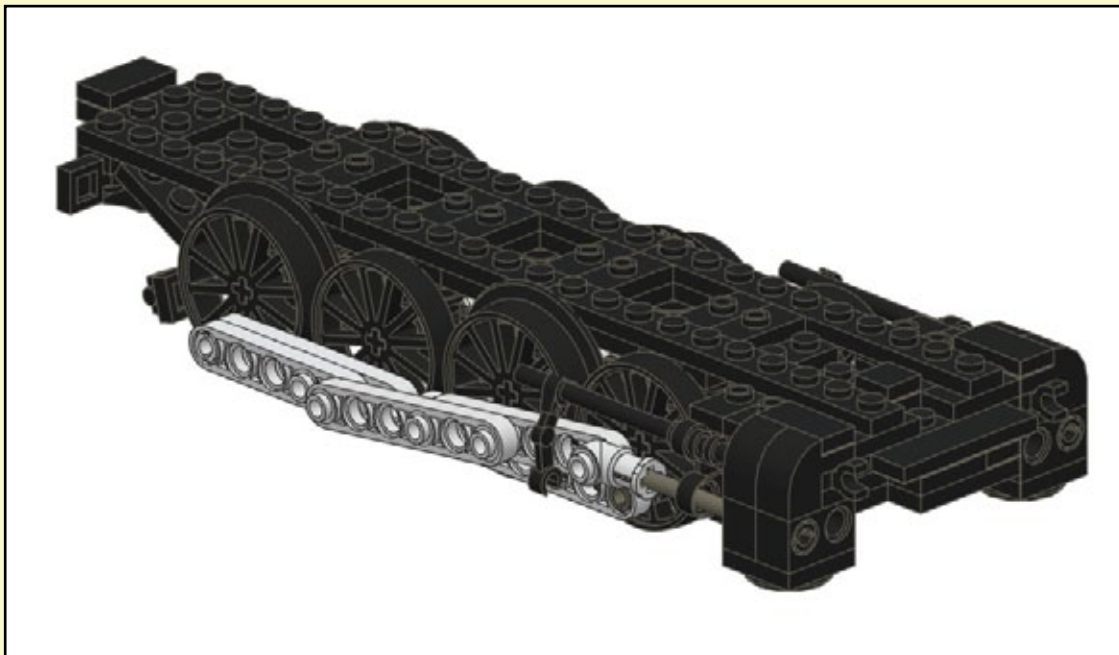
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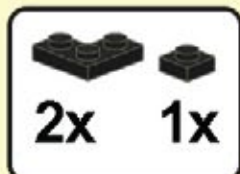
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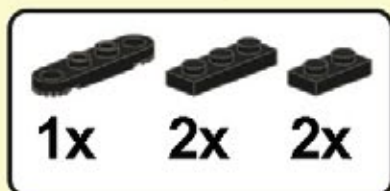
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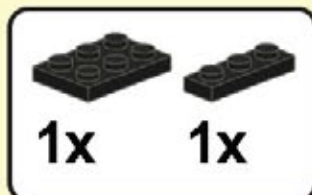
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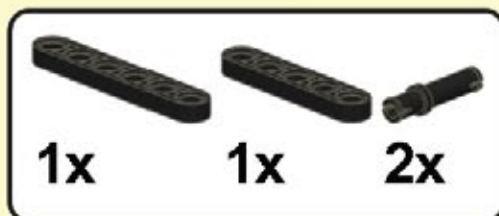
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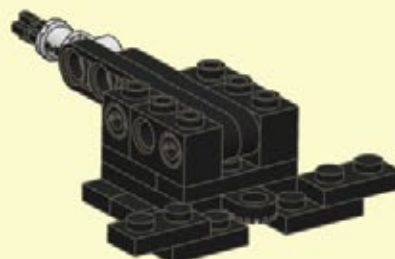
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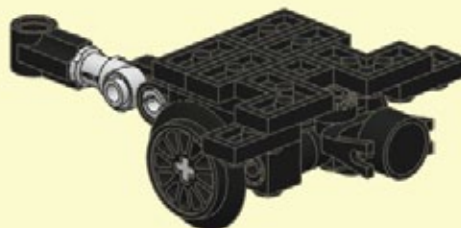
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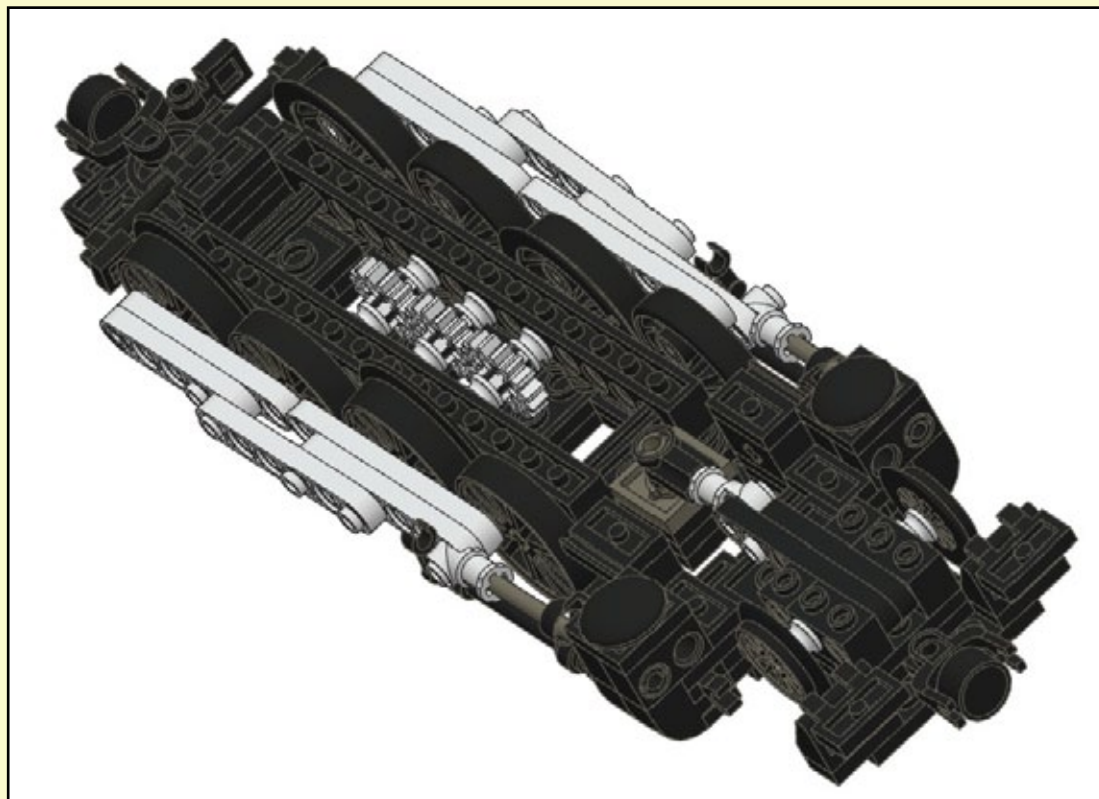
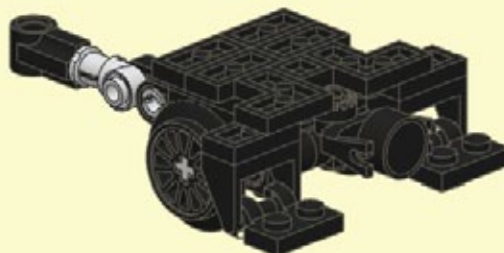
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EMBRACING THE NEW PF SYSTEM FOR TRAINS

by Scott Wardlaw



With the new Emerald Night

from The LEGO Group and some great designs from AFOLS, the new PF System seems like a good addition to many steam locomotives. Now motors can be used to drive the main set of wheels and we don't have to figure out how to make those shiny metal wheels of a 9V motor look good.


This leaves another challenge to overcome for anyone trying to design a modern-era diesel locomotive. Today's locos have two sets of powered three axle trucks that can be difficult to model in the brick. Even in the 9V System with its fixed two axle truck, motors could not be placed on the loco without sacrificing an axle or two.

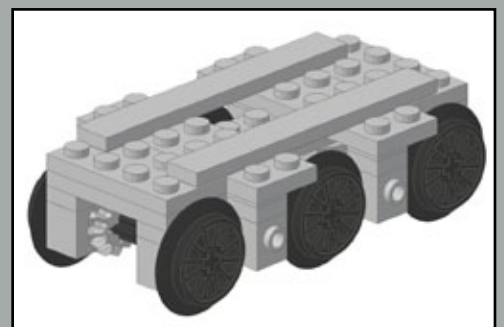
The new PF System lets us hide the motors inside the locomotive and also power the three axle trucks. For anyone that has ever tried to

build a three axle truck, whether it was powered or not has probably realized that the sharp radius turns in the L-gauge track cause these three axle trucks to bind or even de-rail.

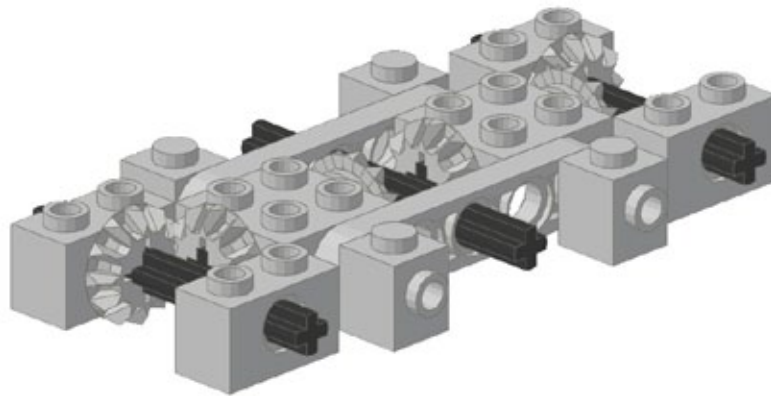
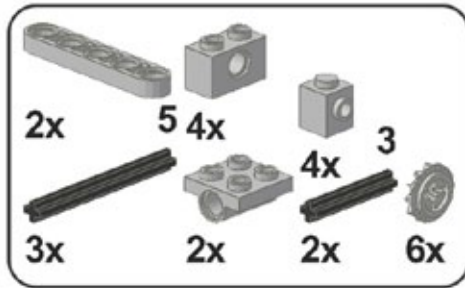
In order to have a three axle truck that freely rolls through the sharp turns the design has to allow at least one axle to float to one side or the other. The design must also not protrude beneath the level of the track, or it will not be able to cross over switch points or road crossings. The design must be strong enough to withstand the torque placed on it from the motor. Lastly, the design must also allow for attachments of wheel covers, couplers, and possibly stairs.

If you follow the trains group on Flickr, you have probably seen

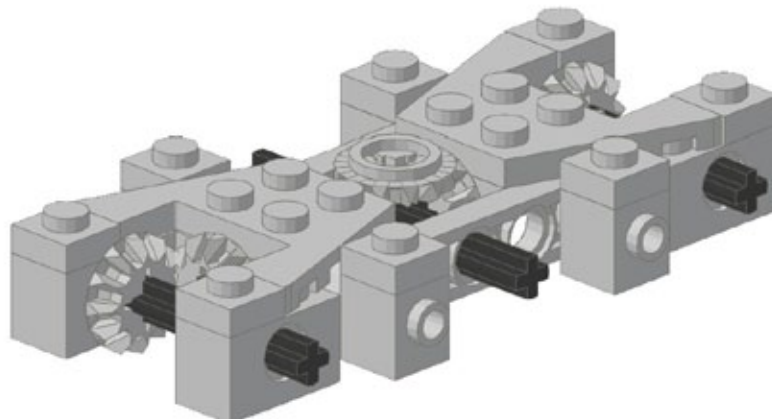
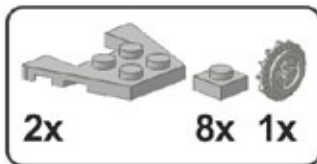
some good non-powered designs by some talented AFOLS. After many months of designing and tinkering, I think we finally have a design that can be powered by the new PF System and meets all of the above qualifications. I hope that you enjoy building this sub-model as much as I have and I hope to see some creative wheel cover designs for what ever model you attach them to. 



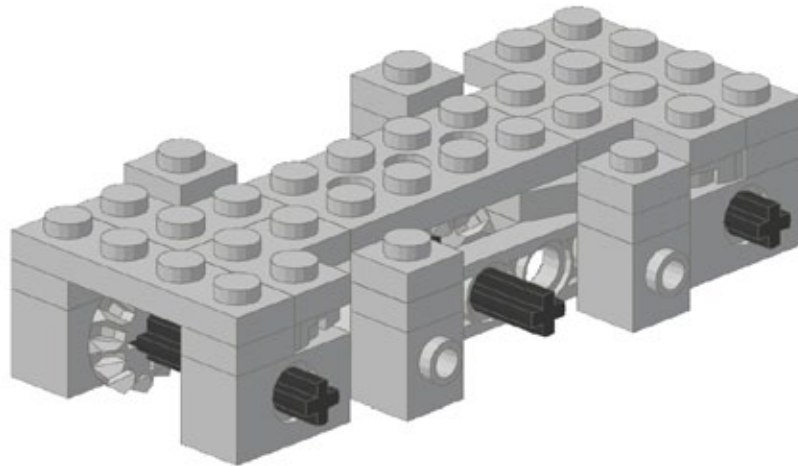
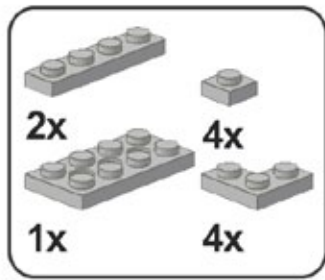
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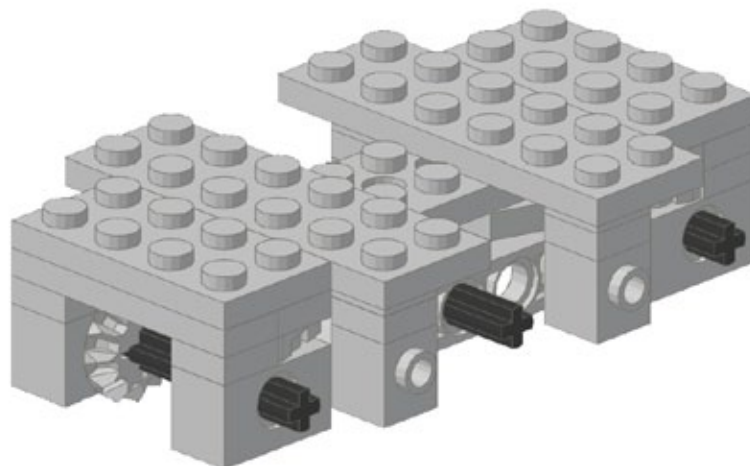
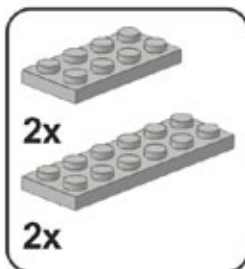
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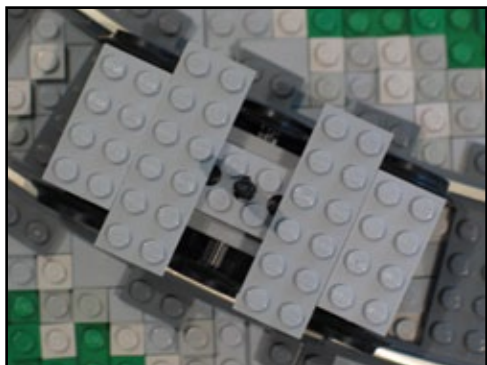
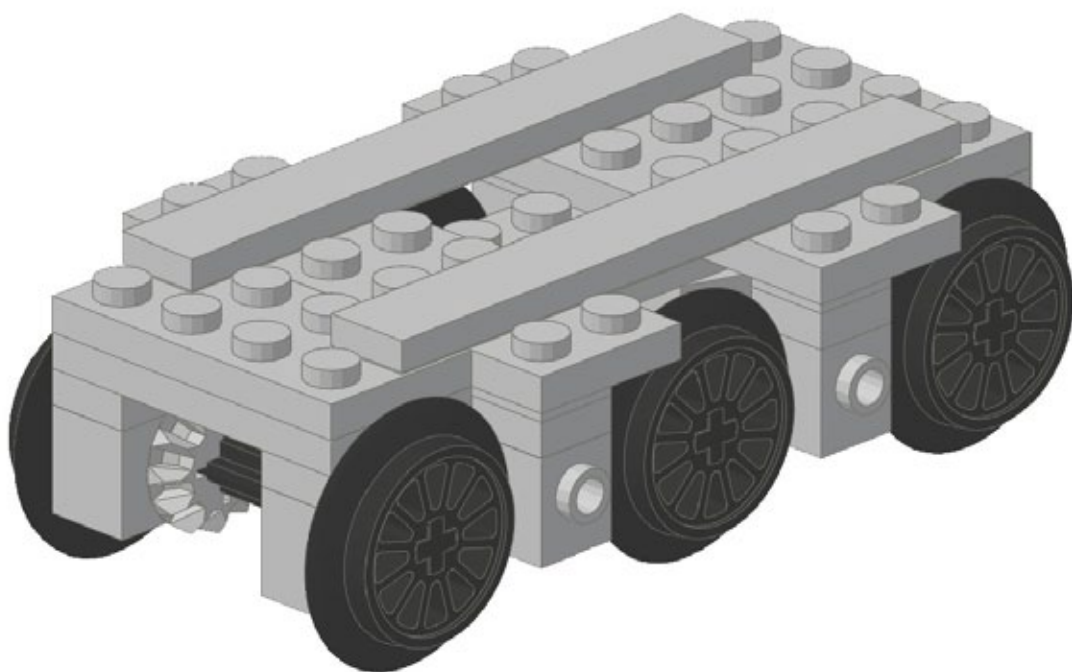
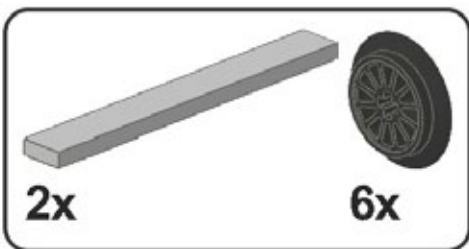
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One of the most memorable scenes from the movie Indiana Jones and the Last Crusade shows Indy as a boy scout saving the Cross of Coronado from grave robbers who chase him across the top of, and through, a moving steam train. This sequence was filmed on the narrow gauge Cumbres and Toltec Scenic Railroad in Colorado using rolling stock painted-up by Lucasfilm artists to depict a fictional circus train of the 'Dunn and Duffy Combined Circus.' Heading up the train was locomotive #484, a K-36 class steam locomotive built by Baldwin in 1925 and which is still operating today. Several flatcars and boxcars were loaded with various circus related cargo and painted in colorful hues. The caboose, in a homage to producer Frank Marshall, was lettered "Doctor Fantasy's Magic

Caboose." When I set out to create my new LEGO display, Indiana Jones Brick Adventures, I knew this was a definite must have. It was a joy to build and share this wonderful piece of steam train history with a new generation at my club's shows.

The locomotive is an "outside frame", meaning that the drive wheels sit inside the support

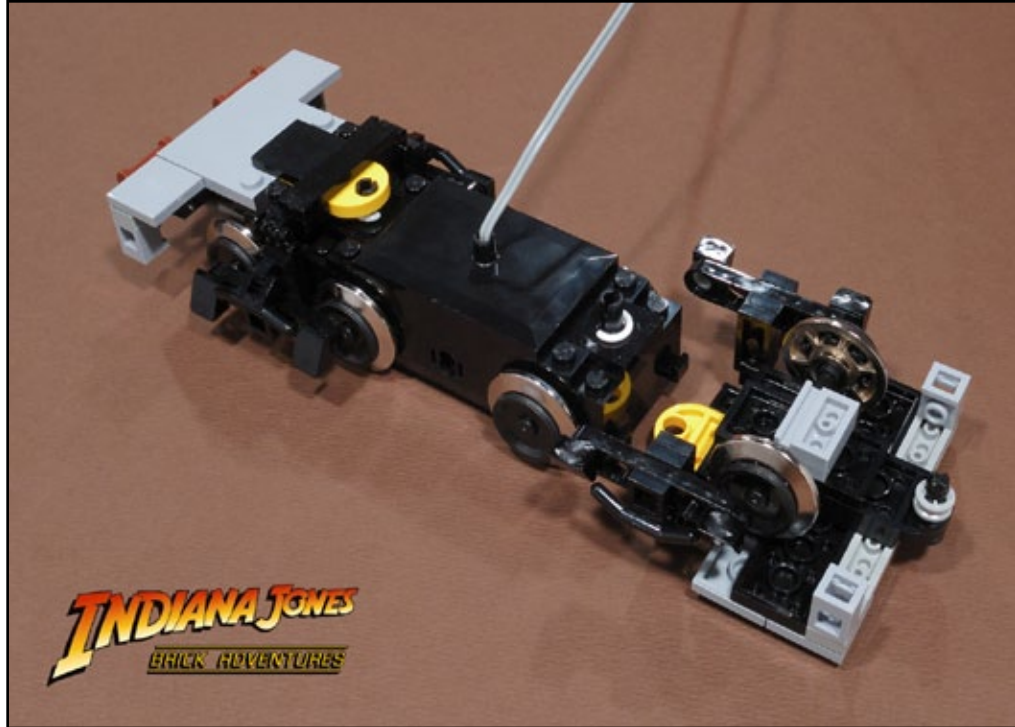
frame with the axles extending through to connect to the counterweights and cranks outside. I used 2x8 Technic plates for the side frames which actually hang off the axles running through an RC train motor. Technic crankshafts connect the four axles (not only two axles have wheels) to the main drive rods assembled from Technic flex connectors using custom length flex rods. The





valve gear linkage operates and provides the characteristic movement in addition to the main rod movement. The lead and trailing trucks are both outside frame as well but use different techniques to accomplish this. The lead truck journals are supported by plates snotted out to provide clearance for the cylinders on curves. The trailing truck uses 1x6 inverted slopes snotted around the wheels.

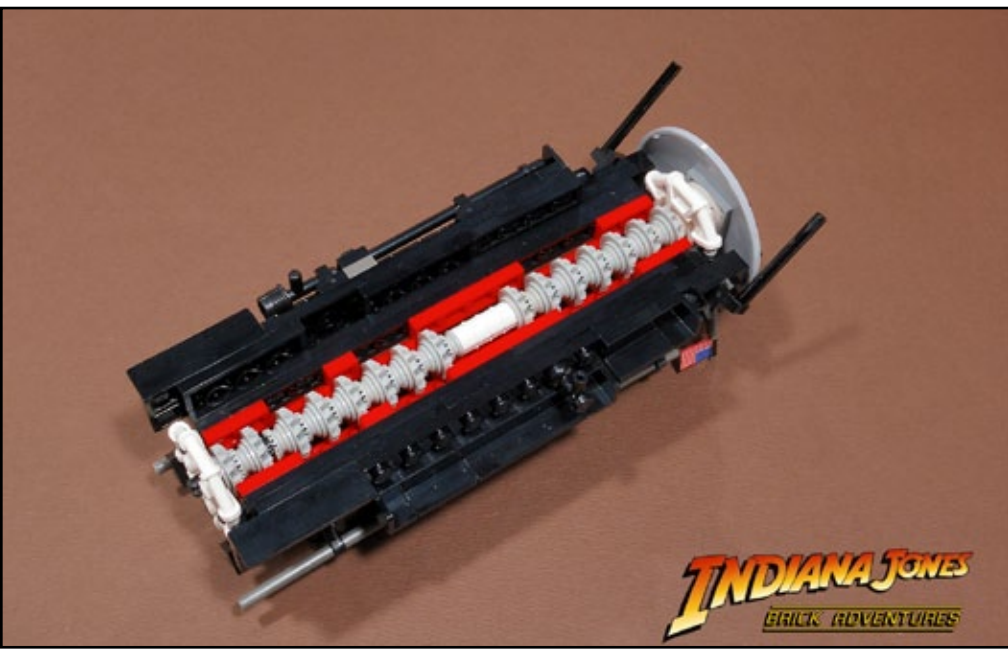
The boiler design began with Cale Leiphart's Pennsylvania E6 which used 2-stud wide plates snotted in radial fashion and makes it easy to attach piping. But turning this into a single stud radial boiler was a challenge. The trick is to support the plates on an inner core made of bevel gears with octagonal mod plates on the ends. The rows of plates on the 45deg angles have 1x1 clips to attach to



the octo-bars. The other rows of plates between these interlock and are actually held in place with the rubber "boiler bands."

The tender contains a 9v train motor which provides additional traction and provides power to the RC motor in the lok. To achieve the correct proportions the tender motor is placed in the center with "faux trucks" swiveling around the ends. I first used this approach on the tender for my Frisco 1630 seven years ago but have now improved on it by replacing the black plastic train


wheels with actual metal 9v wheels that match the train motor wheels. First open a 9v train motor and collect the wheels from it (typically from a burnt out motor). Pull the wheels from the axles and then re-attach the wheels to an RC train wheelset axle, which have blunt ends, and attach to the faux truck using 1x2 mod plates with door rail.





If you want to see more photos of this train, please visit my Flickr page at: http://www.flickr.com/photos/brian_williams/sets/72157614731023767/



The boxcars use dark red 1x tiles SNOT-ED vertically to resemble wood sheathing and hinged dark grey tiles for the roof. Inside they are mostly hollow to save weight. SNOT sides provide convenient points to attach the tension bars at the bottom. The archbar trucks are made by SNOTing handle bars and Technic lift-arms with cheese slopes to represent the journal boxes on the ends of the axles. The cheese slopes are attached using TAT construction (Tape and Tube) with short bits of Plastruct tube available at most hobby shops. The colorful custom decals were made by painstakingly redrawing the artwork taken from photos of the actual cars used in the film. These really capture the spirit of adventure from the film. In addition to the animals and heralding on the cars. There are also custom mini-figs for Indy and the Fedora gang (Fedora is the name of the man in the black leather jacket who inspired Indy and gave him his first Fedora). 



Billund's Miniland Trains

The average LEGO train fans are familiar with the 6-stud wide train models from the LEGO company. But the company also exhibits much larger train models in the Miniland at LEGOLAND parks, now operated by the Merlin Entertainment Group.

However, these models are far less well known as not everyone can easily visit one of the four parks. That is why RAILBRICKS has decided to present some of these LEGO train models from Billund's Miniland.

The Miniland is divided into subsections, each one presenting a typical spot (Kennedy Space Center, Billund's Airport), country landscape (Japan, The Netherlands) or Tourist spot (Rhine Valley, Hollywood Boulevard).

This diversity allows a large collection of train models to be exhibited, from the Japanese high speed train «Shinkansen» to diesel shunters and tourist steam trains.

The models are around 18-studs wide. This is quite big - of course, this is not «minifig» scale anymore but Miniland figure sized, eg 1:20.



*Article and photos
by Didier Enjary*

In this issue, we will first have a closer look at tracks and trucks, and then at rolling stock, stations, and lines. Just like the park, this series of article is divided

into country specific sections. We will discover the largest trains layouts (Danish and German) in the next issue.

How Stuff Works ...



Due to the unusual scale of these LEGO train models, the tracks and train wheels are of a custom made kind. Have a close look at the wheels on the green shunter in the Copenhagen harbour. You can see that, just like the Big Ben Bricks wheels, they exist both in the flanged and blind type.

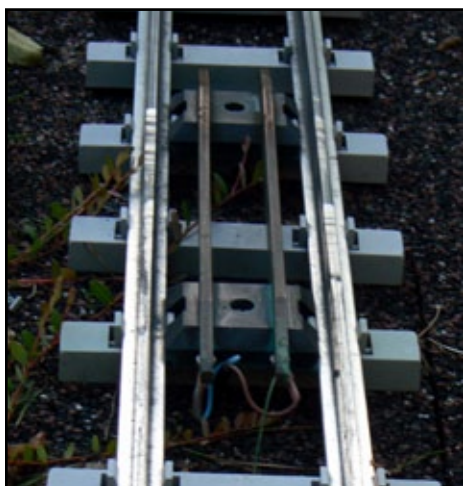
Tracks are also custom made, and not electrified, and while some points (switches) are functional, others are fake.

Safety considerations and outdoor conditions lead to a self-powered engine solution. An electric motor drives one set of wheels and thanks to a notched belt, the other wheelset of the truck (bogie) is coupled and driven.

Batteries are recharged at specific locations (sheds, tunnels, stations, end of lines...) where engines stop for tenths of seconds.

...or not

Outdoor conditions sometimes make the train layouts operations tricky : rain, sun and wind, small animals, plants and fallen leaves, are responsible for faded or yellowed colors, dirty and broken parts or dismantled assemblies and even train derailments. Not a serious issue, and these details help makes the layout more realistic and enjoyable.




A working turntable

Disclaimer :

All pictures available (full size)
at www.RAILBRICKS.com
All pictures by Didier Enjary,
21-26th of July, 2008,
LEGOLAND Park, Billund, DK



Japanese Shinkansen

 The famous Japanese high speed train is exhibited in a mixed environment of traditional and contemporary Japanese landscape.

More precisely, the (unique) model is obviously inspired by the 300 series Shinkansen trainsets (introduced in 1992) for Japan's Shinkansen dedicated high speed railways. This highly iconic train is made recognizable by its curved front and blue stripe on white paint livery.

The 300 series trains which are in use on Tokaido and Sanyo lines (Tokyo-Osaka-Fukuoka) are found in sixteen-car sets while the model featured in the Miniland has only two. This is understandable as the Japanese layout in the park takes up only a few tenths of a meter of trackline. This short railroad extends between two tunnels. The train model stops for a few seconds in both tunnels and passenger station.



NASA RailRoad



The NASA Railroad is a 38-mile industrial line at the Kennedy Space Centre (KSC) in Florida. From the Florida East Coast Railway mainline north of Titusville, the KSC branch crosses over the Indian River before dividing into two branches to the KSC Industrial Area and NASA launch pads.

To replace aging Alco S2 locomotives, NASA purchased three EMD SW-1500 engines to operate local switching. Each painted with NASA color scheme (red, grey and black), they are numbered 1,2 and 3.

The railroad is used to transport Solid Rocket Booster segments (the orange tank), ground support equipment and construction materials.

The LEGO model features the engine number 3 and two cars. Shunter and shuttle on the same spot!

Credits and further readings :

<http://www.sinfin.net/railways/world/usa/nasa/index.html>

<http://yardlimit.railfan.net/gallery/hd/index.html>

http://www.nasa.gov/centers/kennedy/pdf/192935main_RRtrain07.pdf



The Netherlands

The yellow and blue striped livery is typical of the NS (Nederlandse Spoorwegen) National Dutch Railway Company. At LEGOLAND, two passenger trains commute among windmills, over raising bridges and canals in one of the largest Miniland train layouts.

The "Materieel '64" electric multiple units (emu) built between 1964 and 1976 operate in the Netherlands under the name Plan T and Plan V. The Plan V is a 2-car version (just like the LEGO model) and the Plan T is a 4-car emu. Both are almost identical from the front, easily recognizable with their round noses.





Lyrestad is a Swedish station on the Göta Canal between Stockholm and Gothenburg (Göteborg). The LEGO model features a railbus, probably based on the narrow gauge Yp diesel railcar (YBo5p), travelling through the touristic line to Töreboda.

Further reading :

Swedish Narrow Gauge at <http://www.trefoten.se/sweng.html>



LYRESTAD
STATION



TÖREBODA
STATION





Fløibanen

Bergen Funicular


Bergen is a major Norwegian city surrounded by fjords and mountains.



The funicular has been in operation since 1918. The ride to the top of the Mount Fløyen (with intermediate stations stops) at an height of 320 meters lasts 8 minutes.

The LEGO models replicate older cars. The original ones have since been replaced with cars featuring larger bay windows.

Both cars have a nickname : The Blau-mann (Blue Man) and RotHette (Red Hood).

This funicular is unique in Scandinavia but the Miniland park features another cable car in the Hollywood area. 



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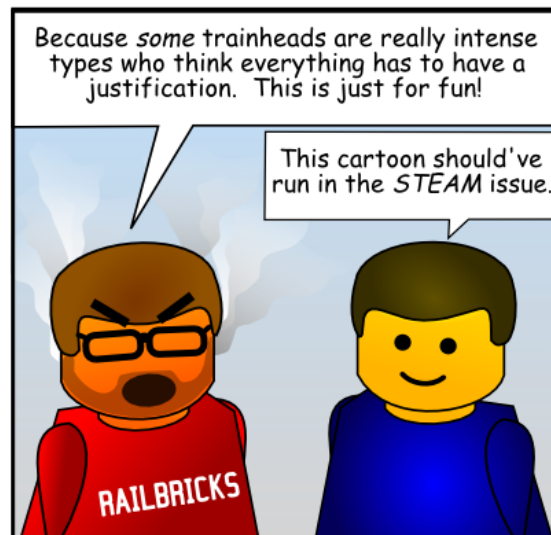
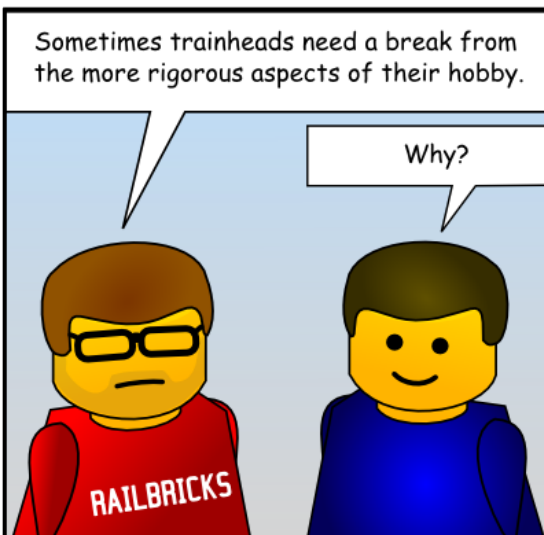
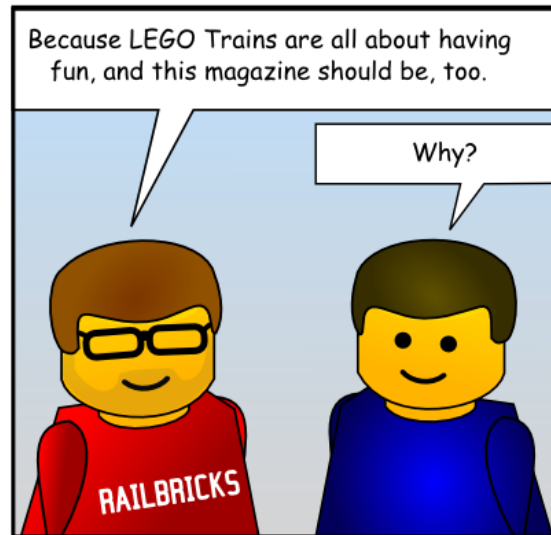
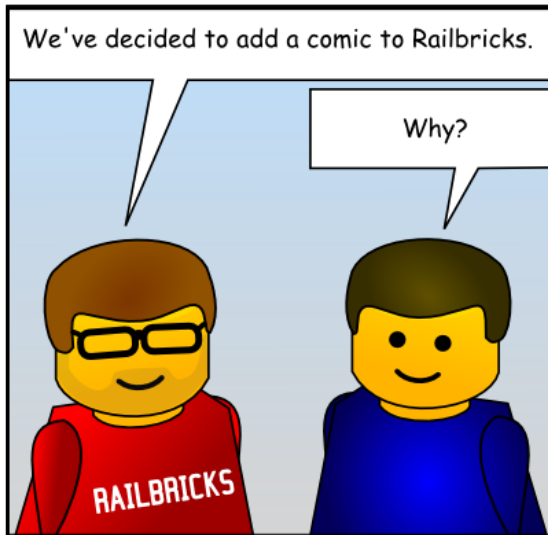
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RAILBRICKS
BUILDING STEAM

THE THIRD RAIL


A RAILBRICKS COMIC BY
JORDAN SCHWARZ



Question: What do you get if you cross a semi truck, a backhoe, and a train?

Answer: The Brandt OTM Tracker! This Maintenance-of-Way (MOW) material handler combines aspects of each, and it's the "Transformer" of the world of trains. It has a specially-modified excavator that can pick up railroad ties and tie plates. For transport, the material handler unit rides on the rear bed of the big rig. When it's time to go to work, the material handler sprouts hydraulic legs and "walks" to the job site. It can even perch on top of gondola cars while busy loading and unloading.

And if that weren't enough, the big truck has some special features, too! It has hi-rail wheels to permit travel on road or rail. It also has a standard coupler in back so that it can serve as a locomotive, pulling gondola cars to and from the work site. The OTM Tracker has become popular with North American railroads as a result of its versatility. It combines the jobs of several vehicles into a single unit and can do the job on road or on rail.

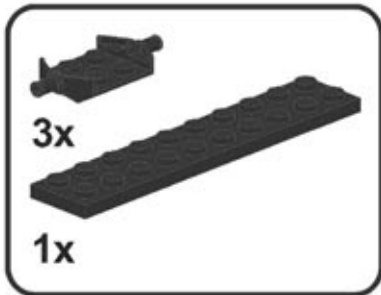
The LEGO version of the OTM Tracker began life as a model created in LEGO Digital Designer. It was intended as a train-related model that could be built and enjoyed even in the period when LEGO was transitioning from one train motor system to another. As a result, it uses few train specific parts, and most of the elements are fairly common. You can use this design as a guideline while incorporating your own special features and bricks from your own collection! 



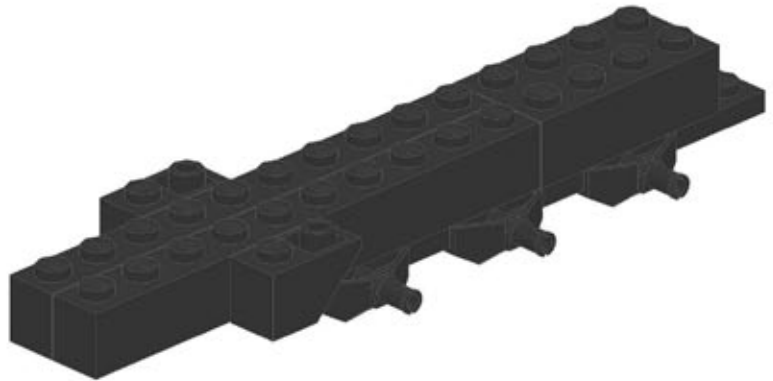
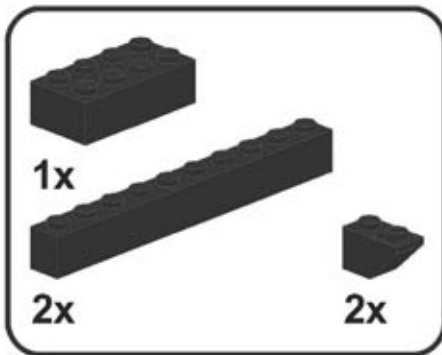
OTM Tracker

by Jordan Schwarz

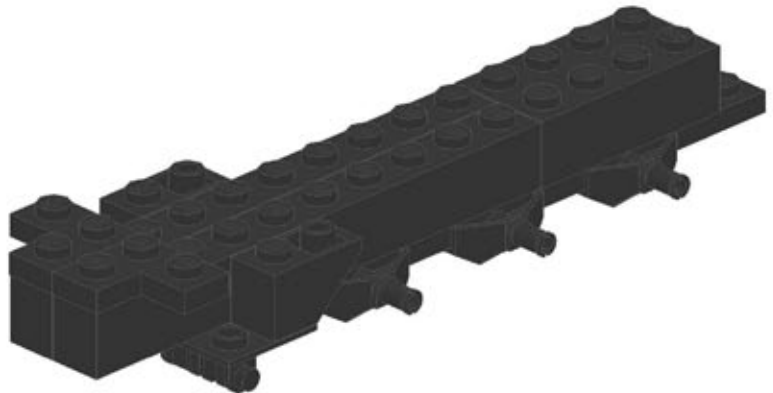
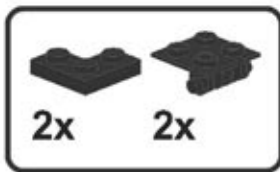
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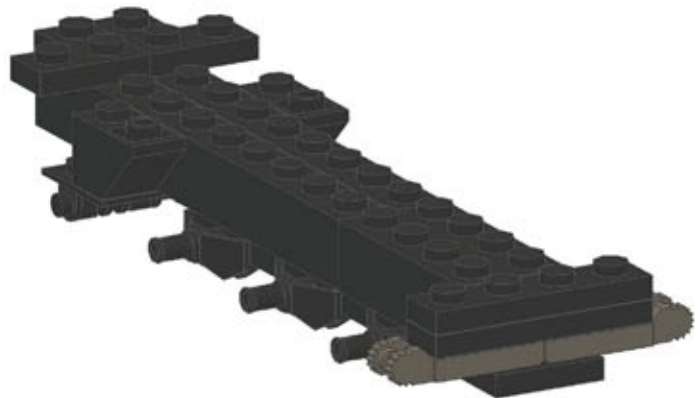
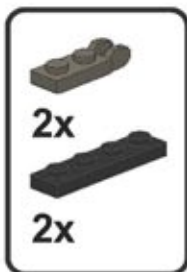
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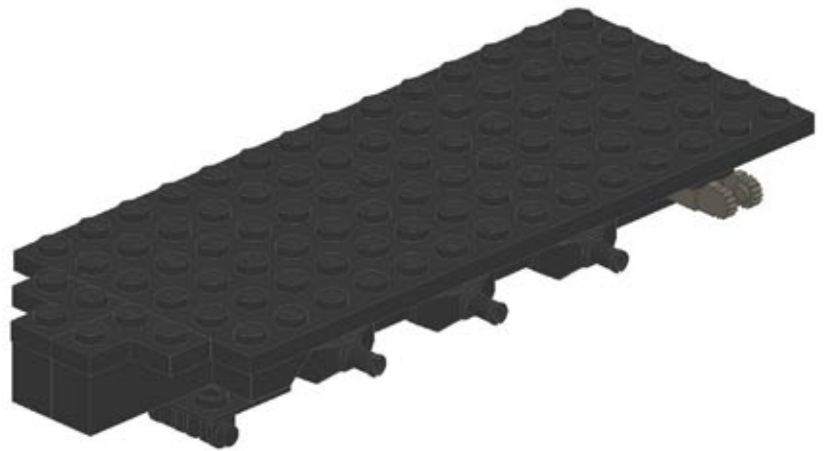
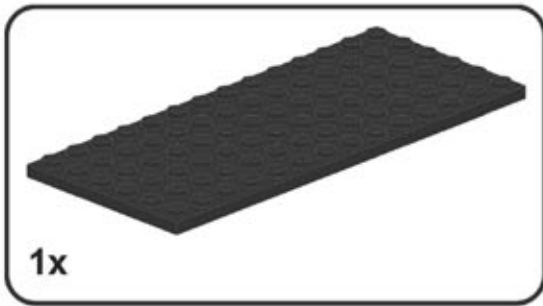
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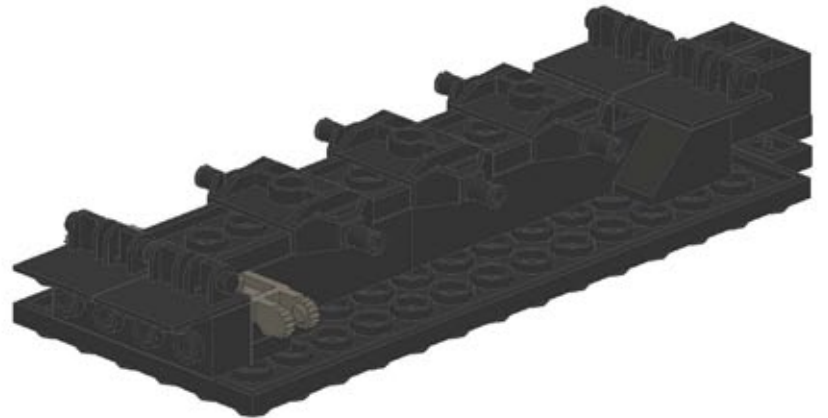
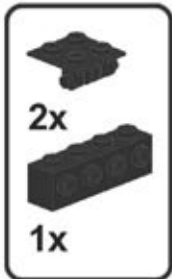
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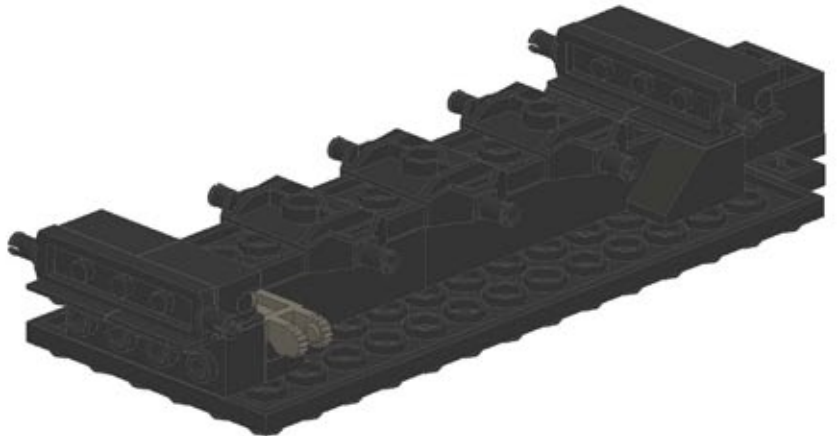
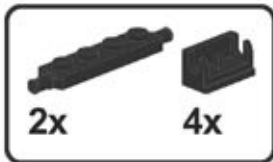
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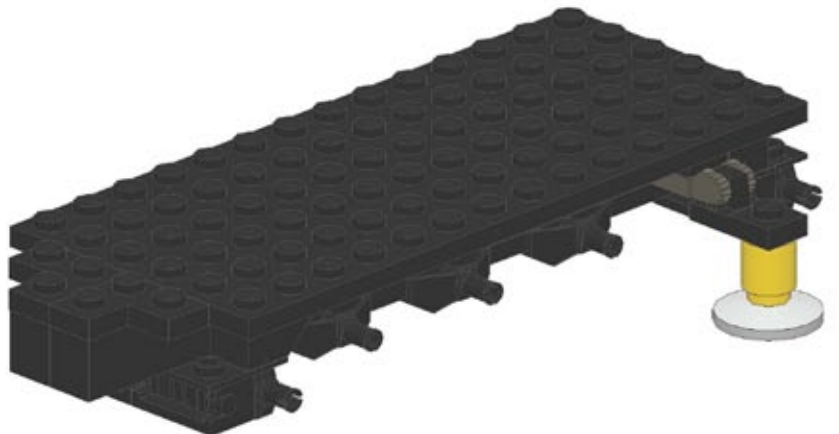
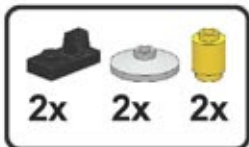
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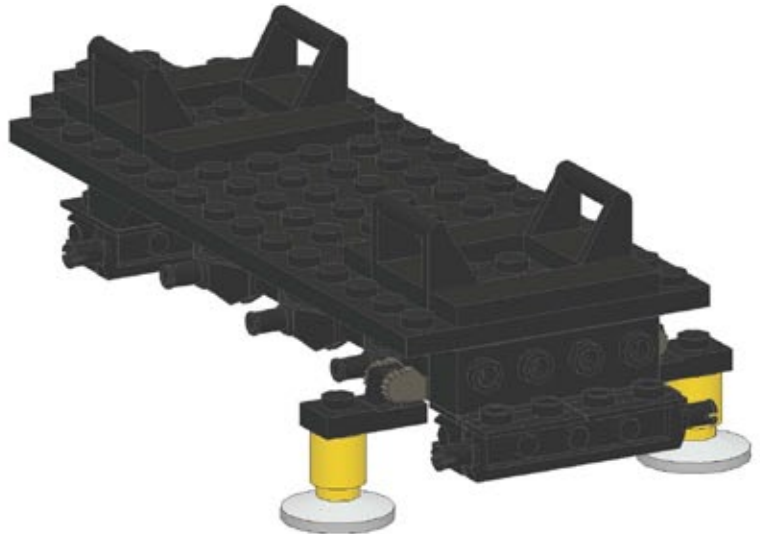
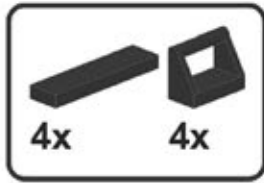
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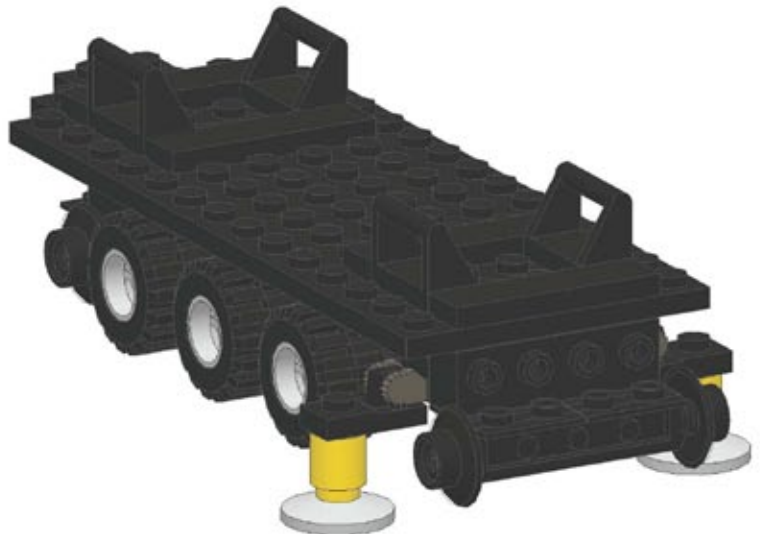
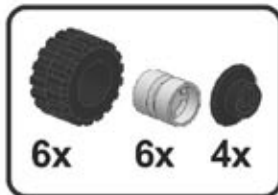
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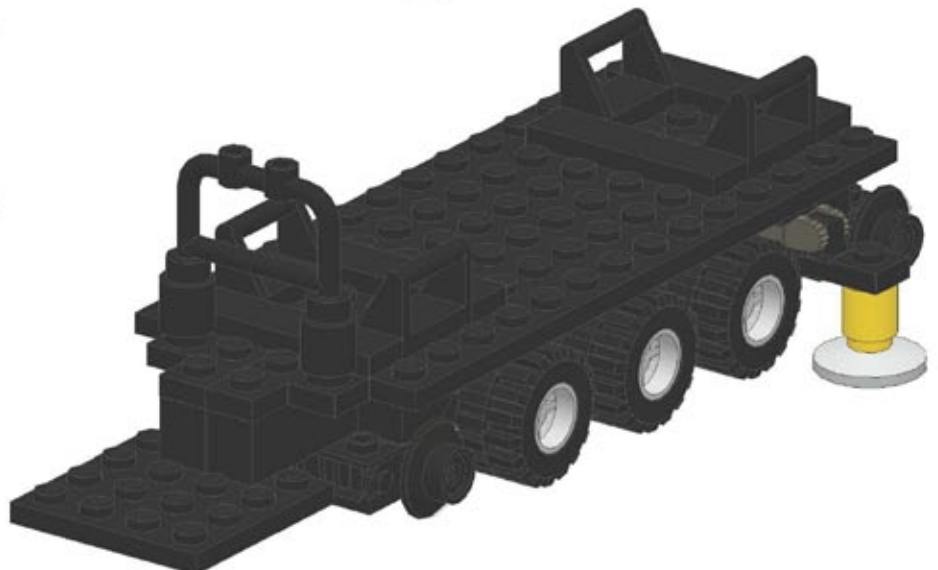
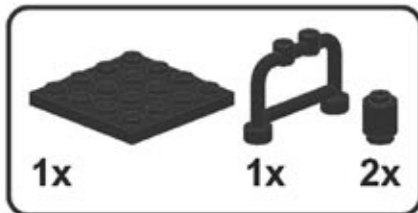
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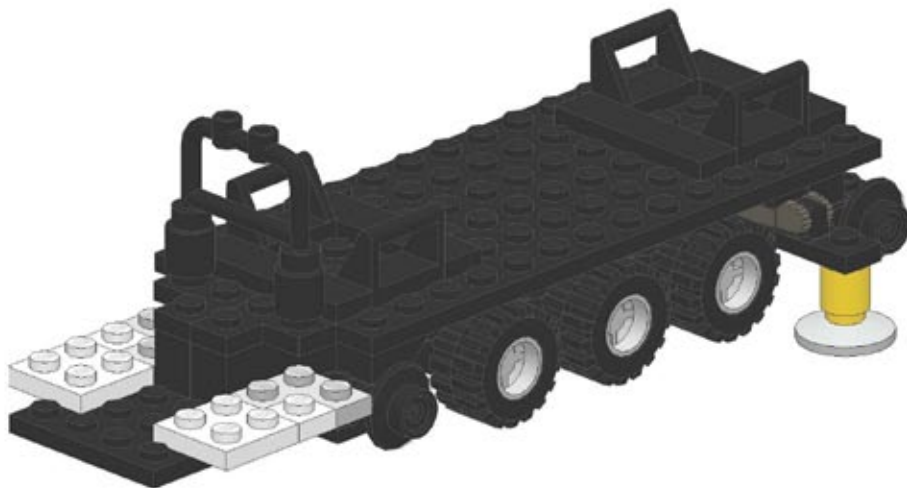
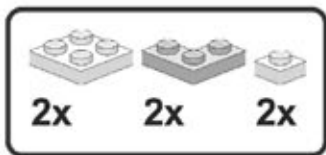
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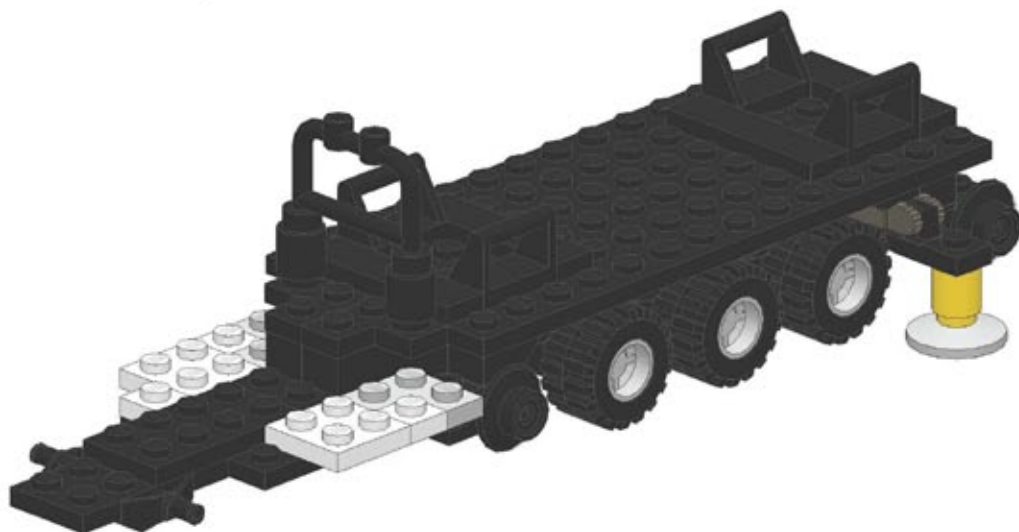
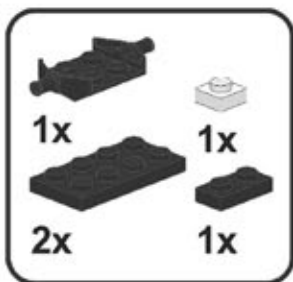
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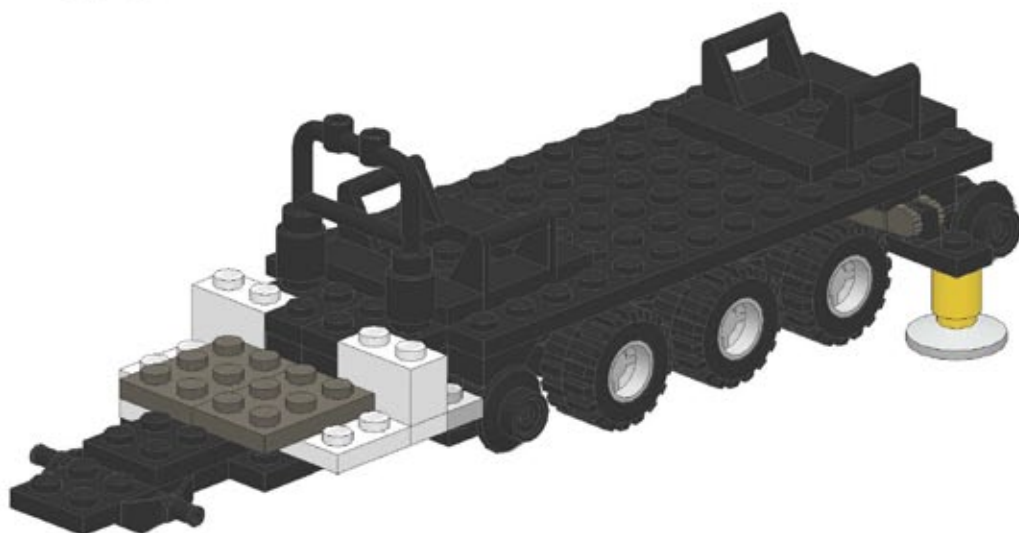
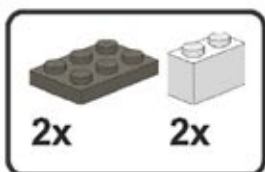
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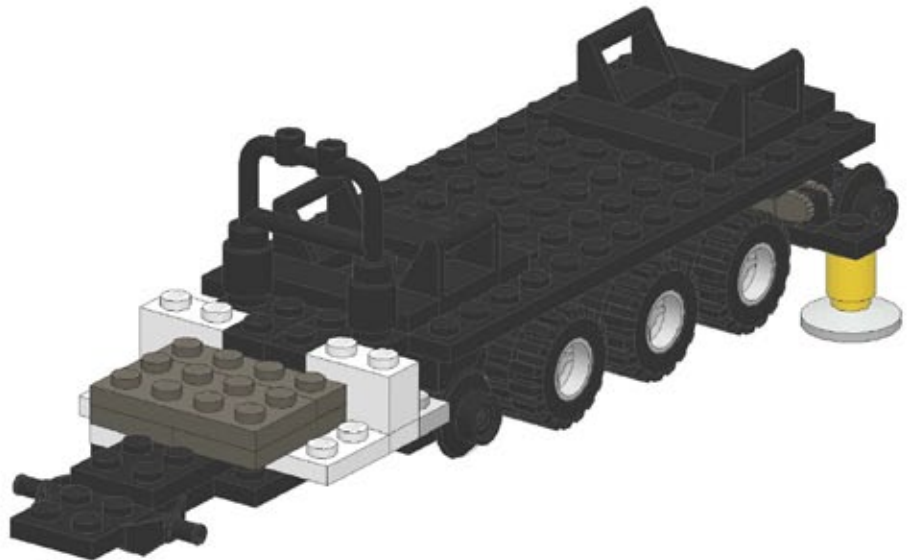
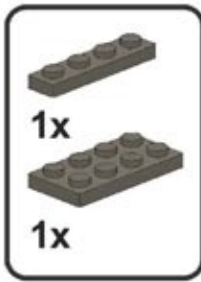
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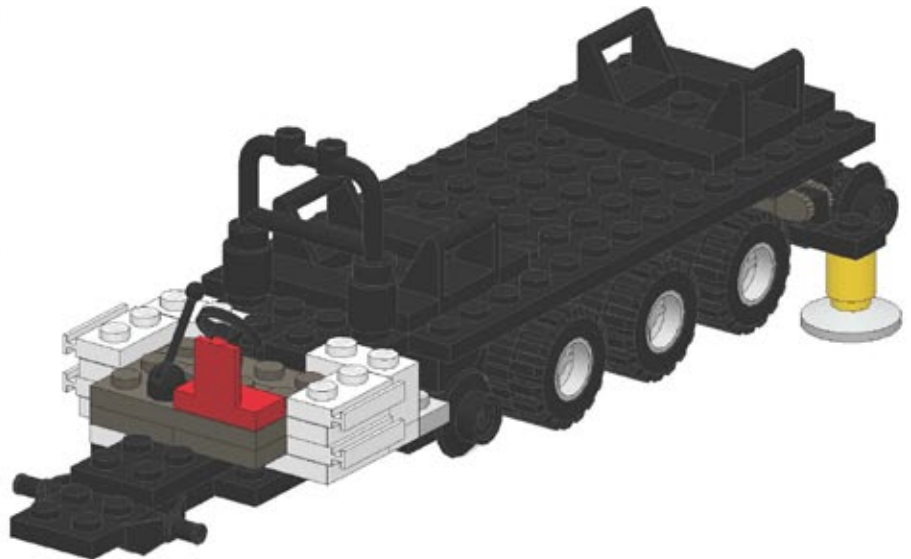
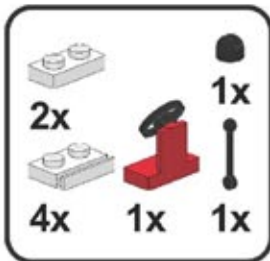
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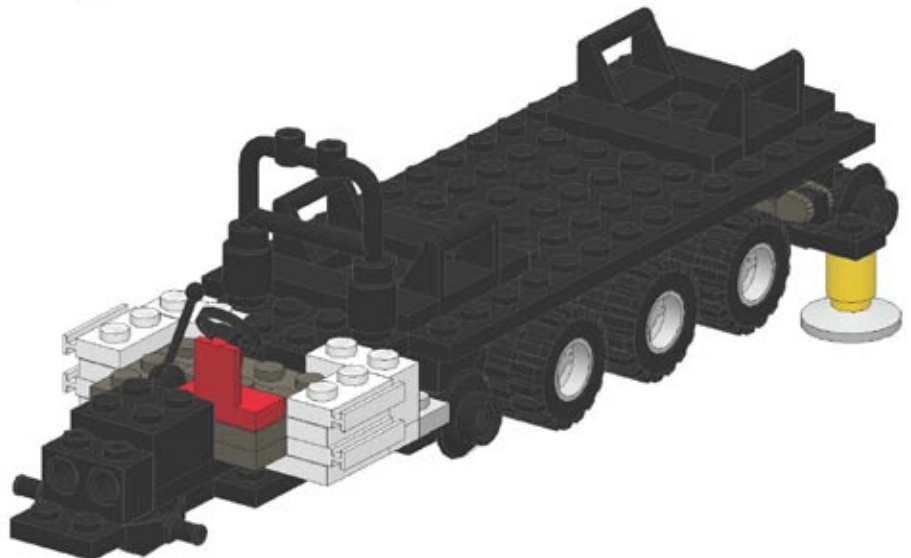
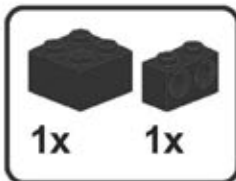
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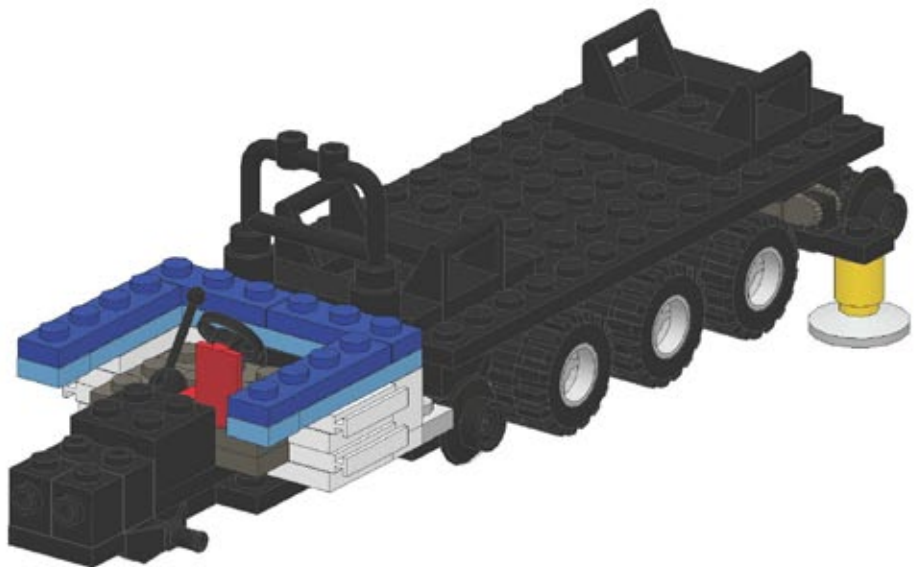
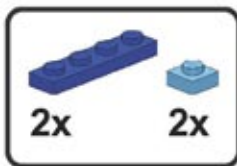
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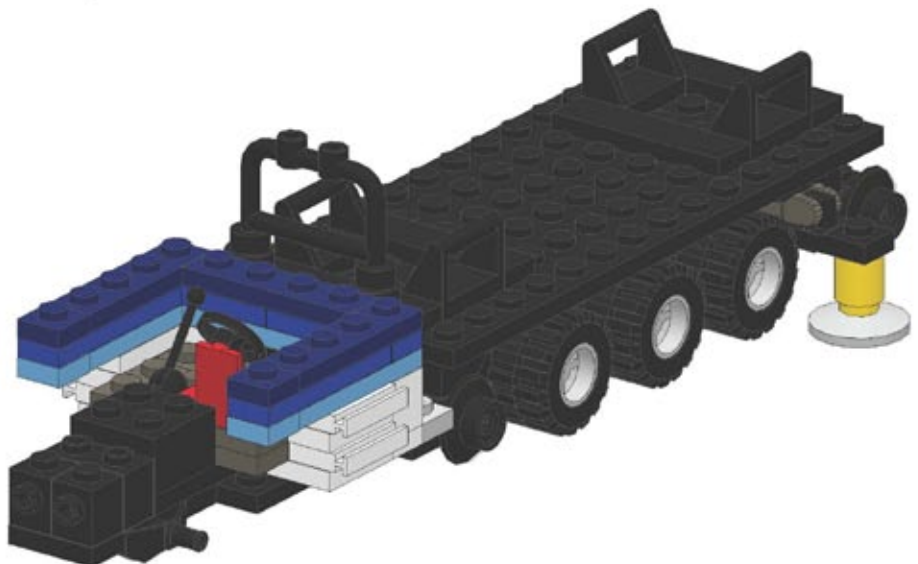
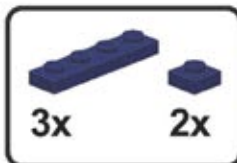
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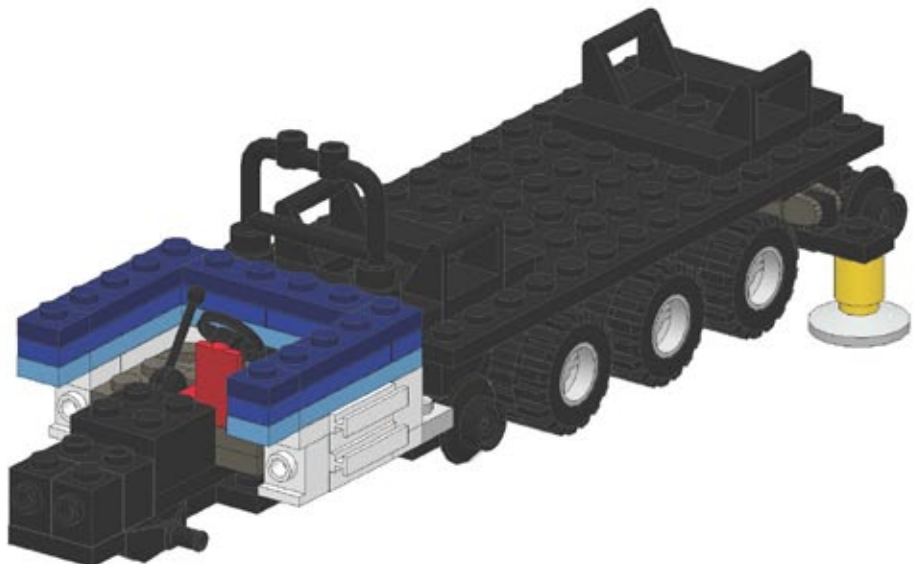
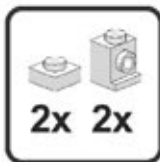
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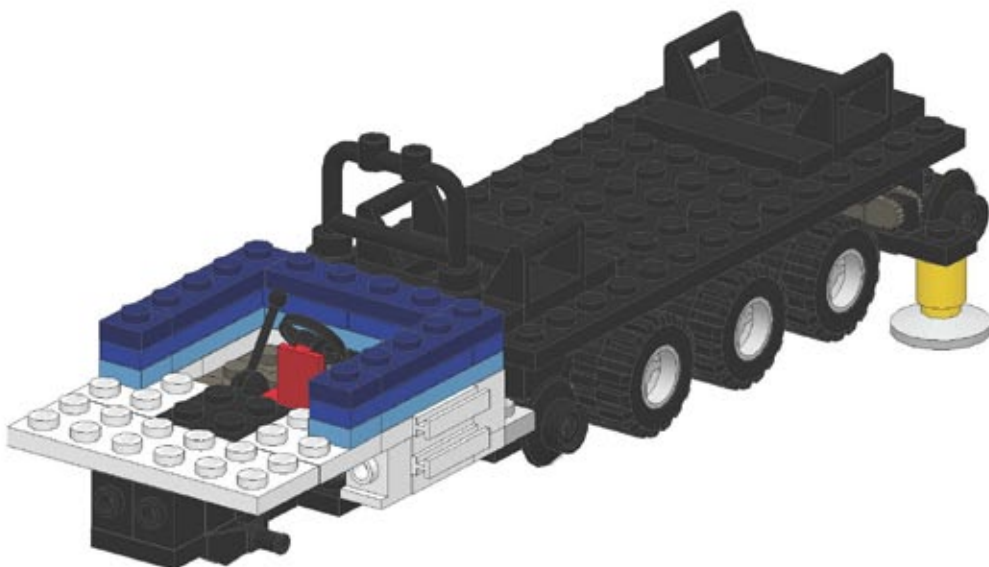
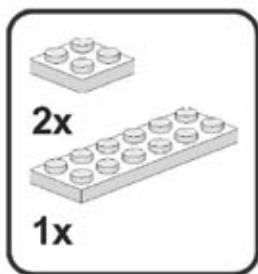
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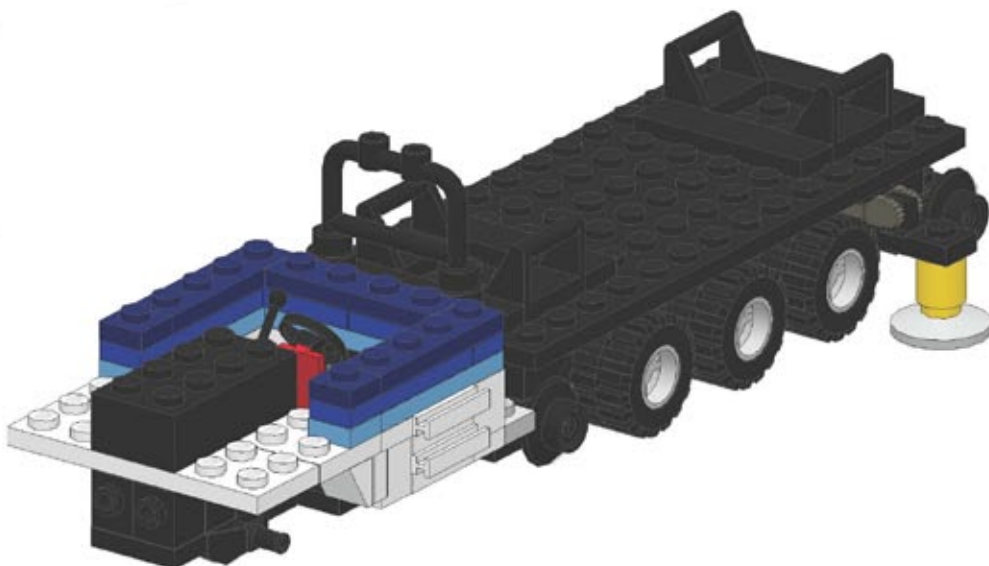
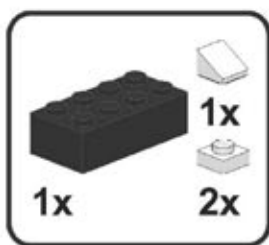
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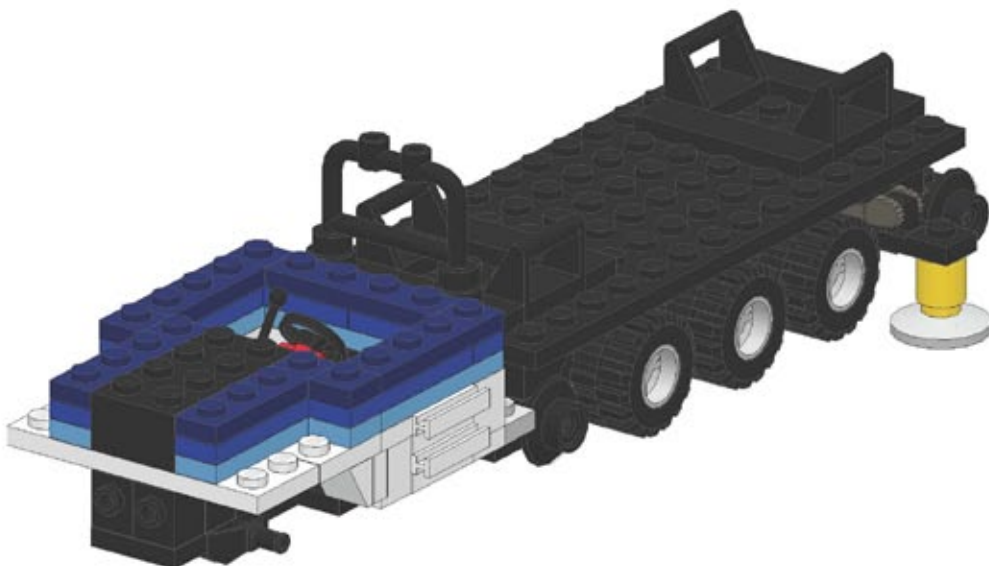
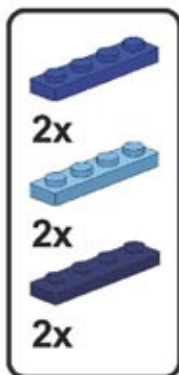
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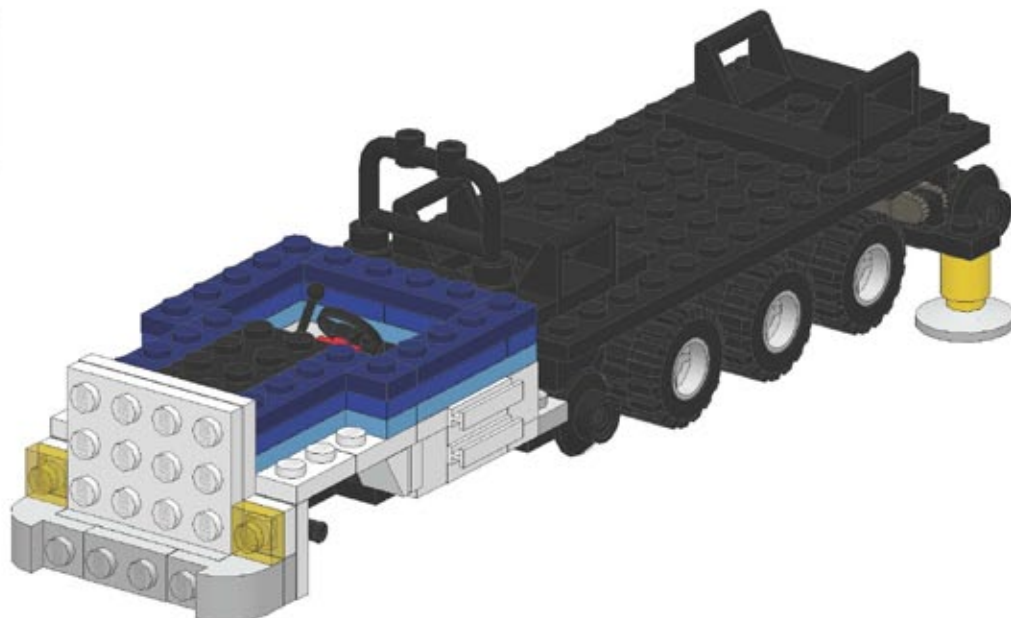
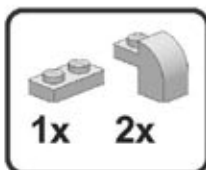
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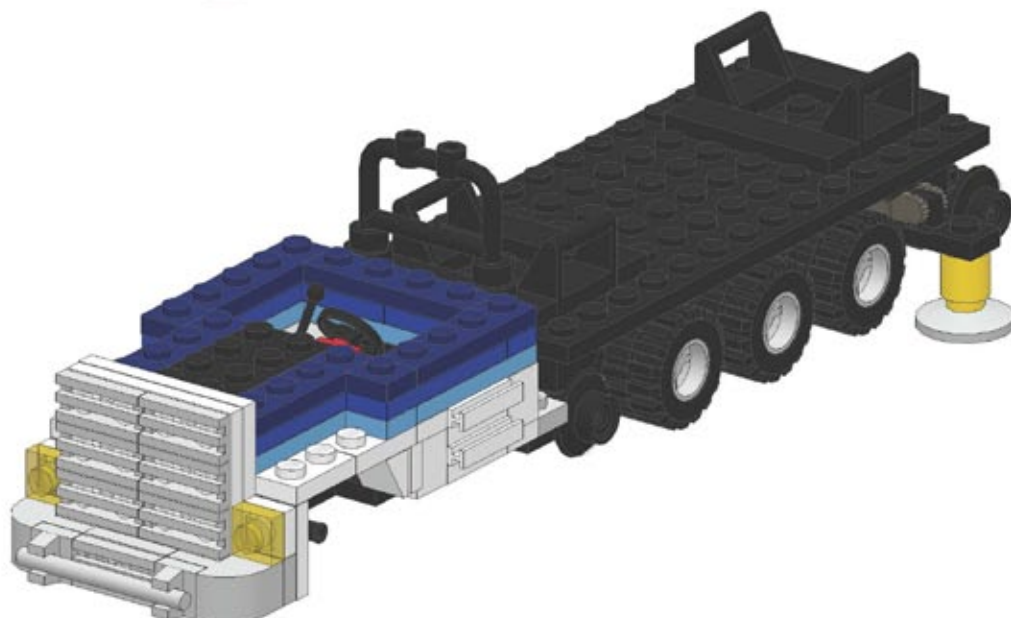
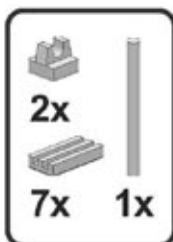
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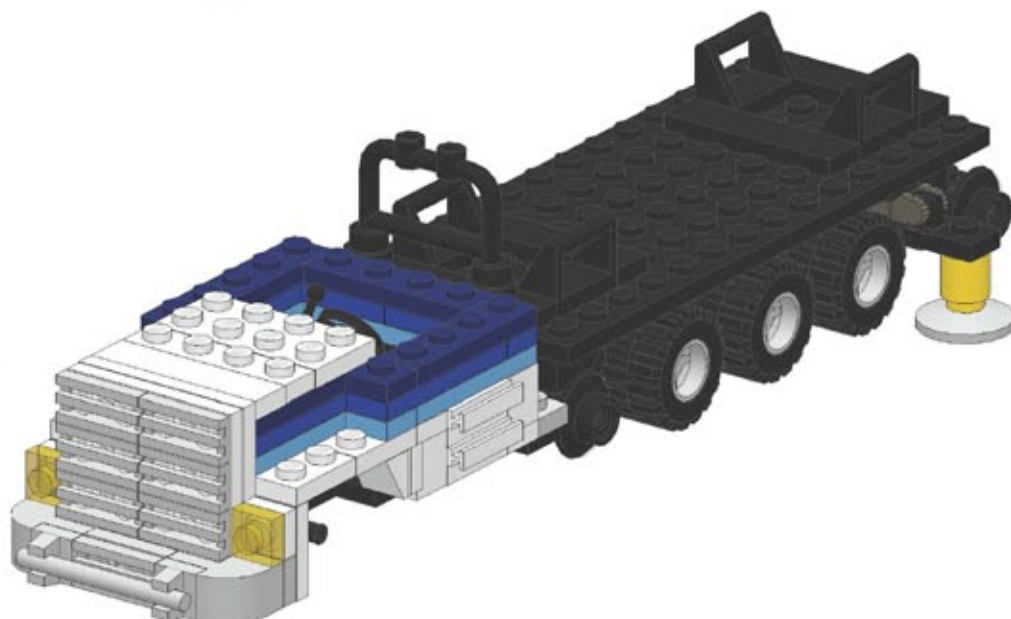
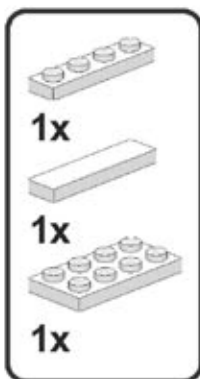
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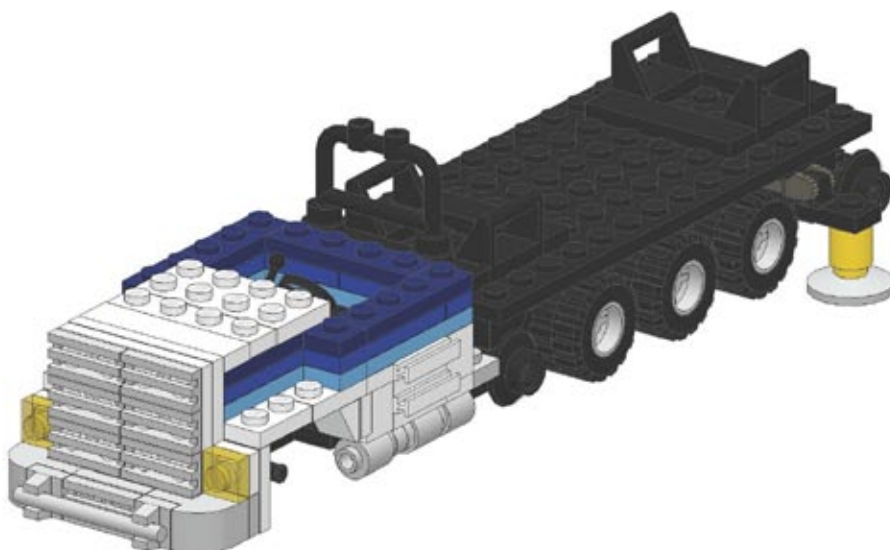
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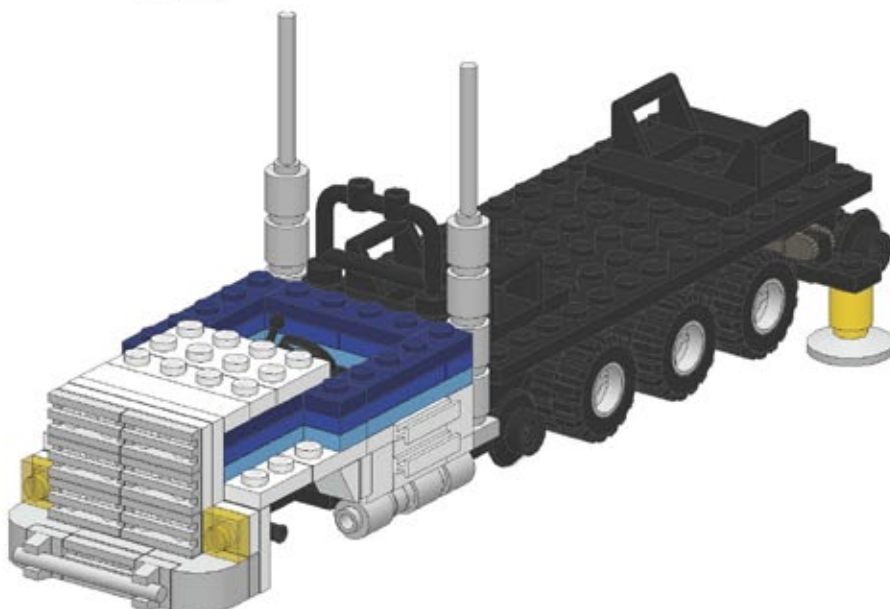
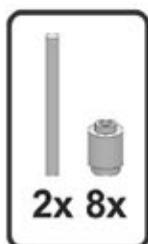
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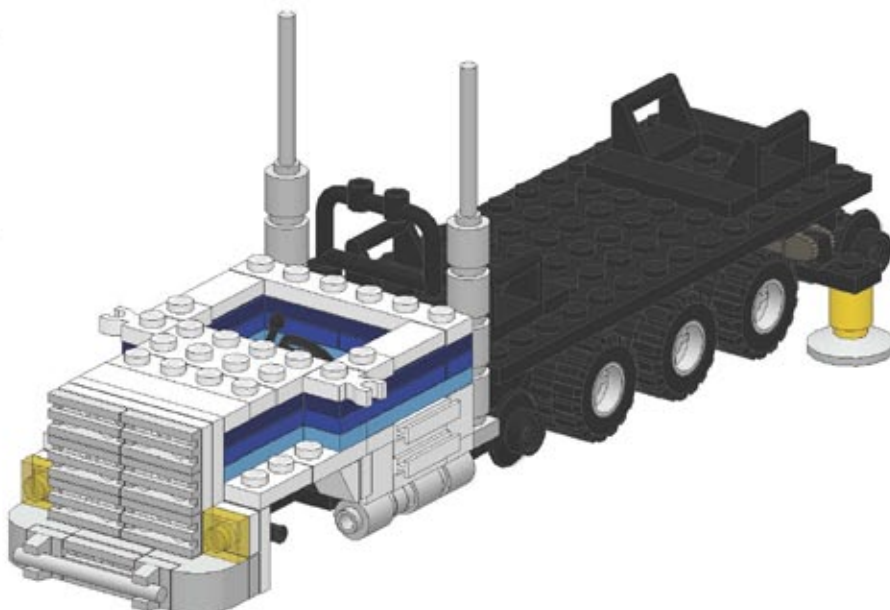
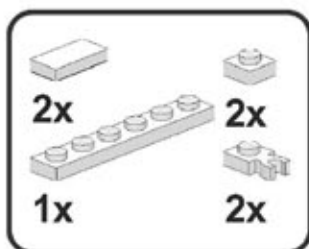
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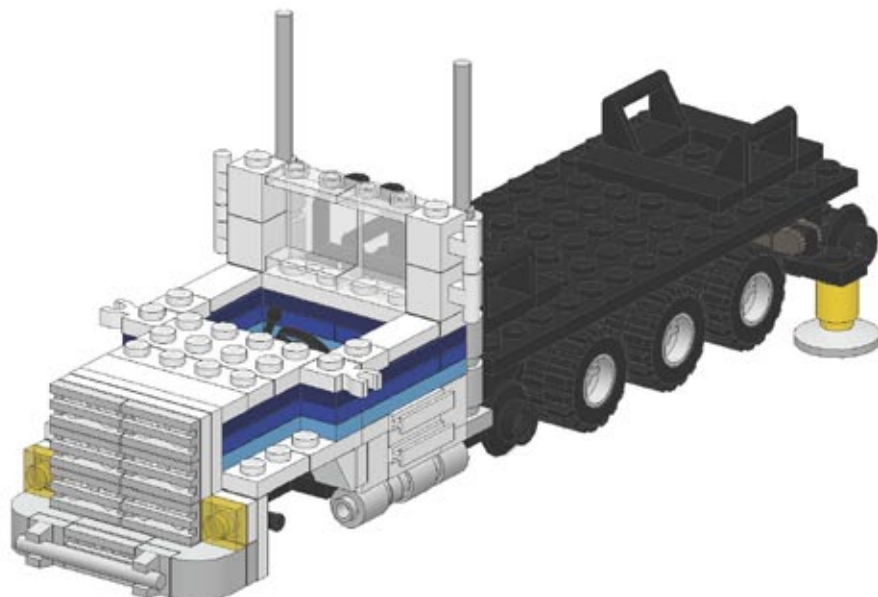
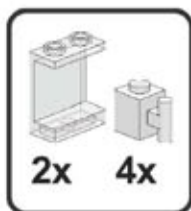
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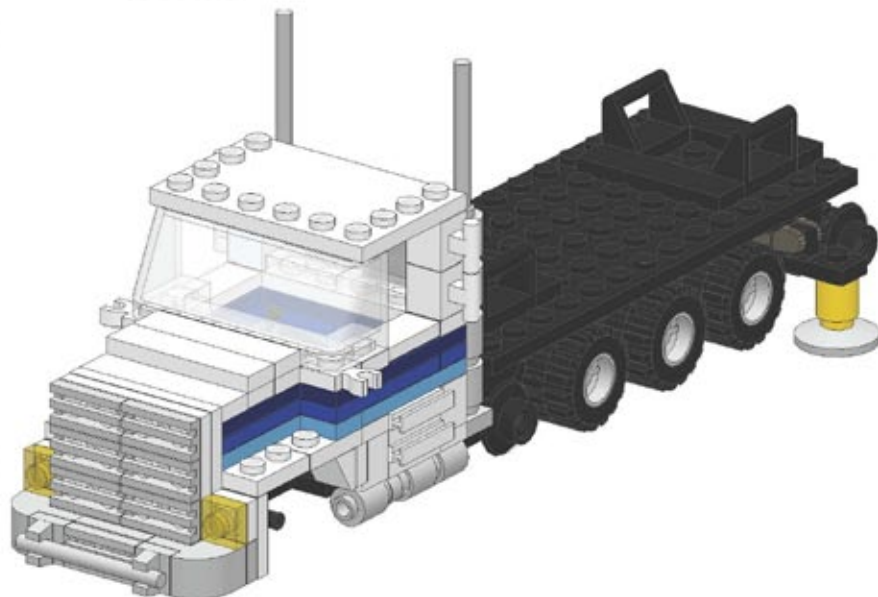
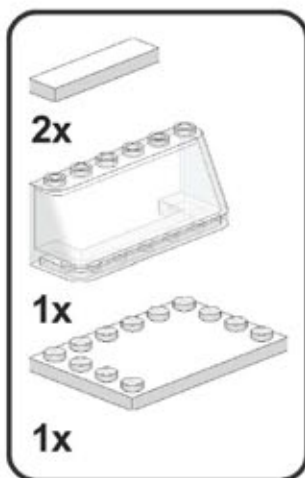
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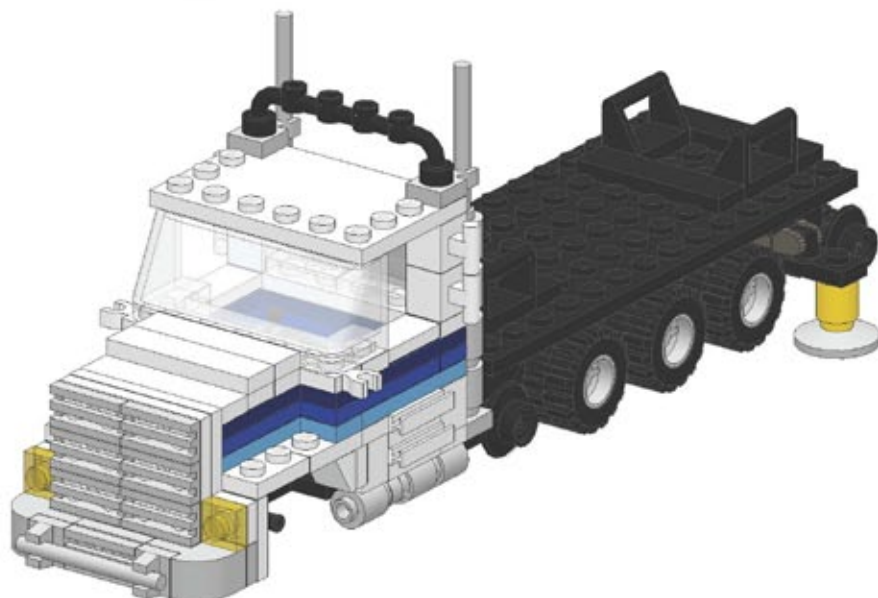
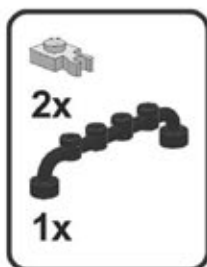
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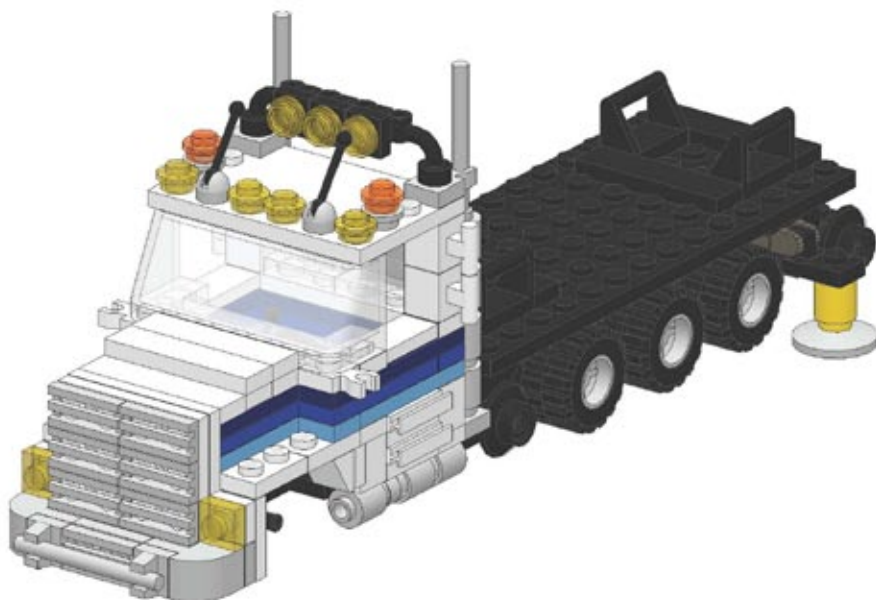
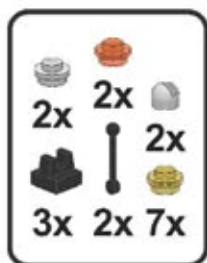
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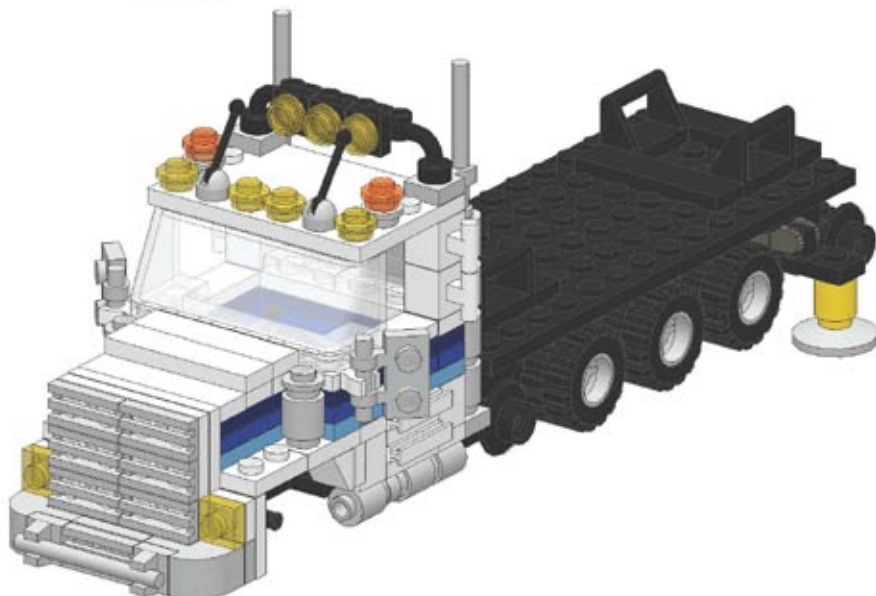
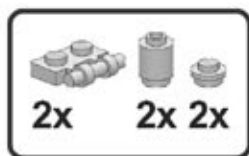
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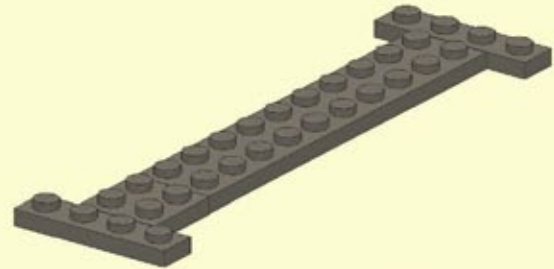
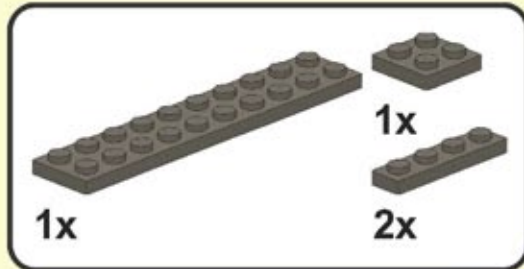
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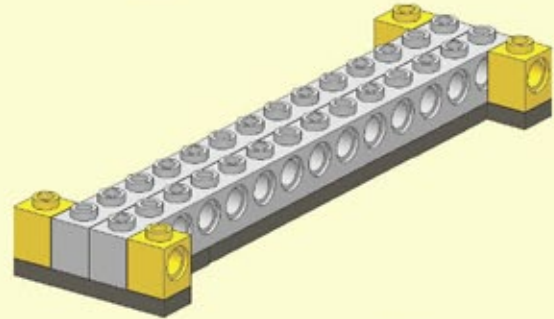
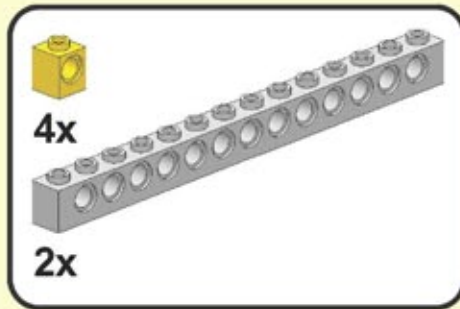
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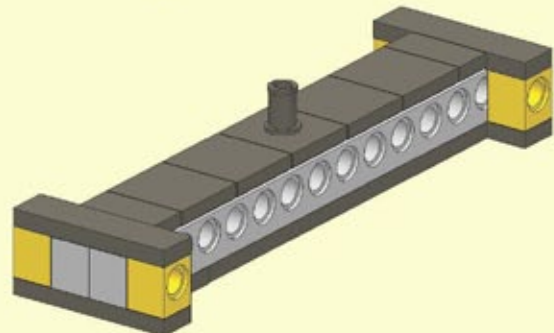
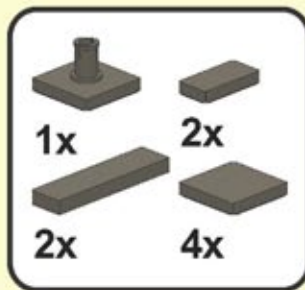
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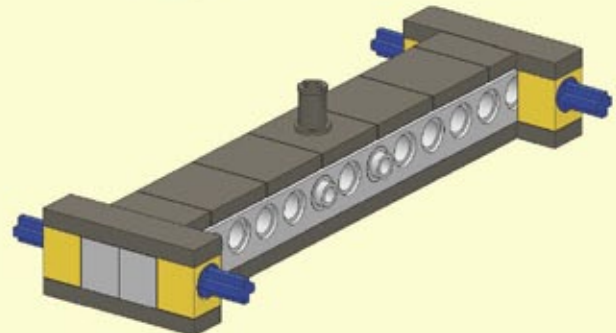
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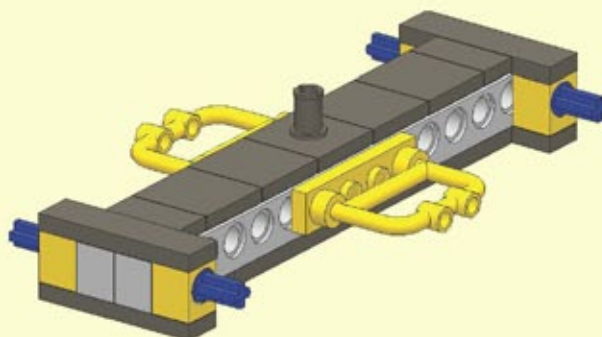
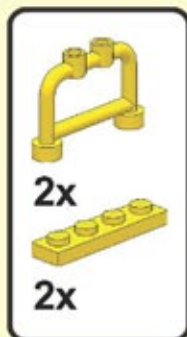
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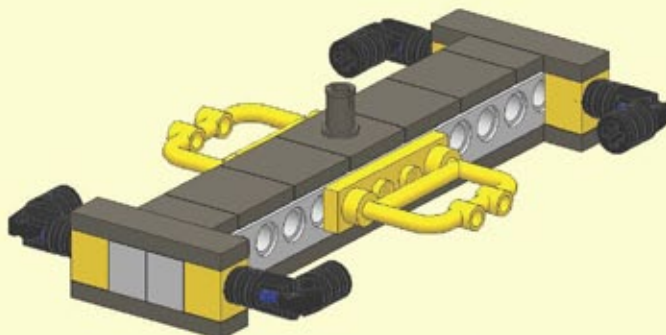
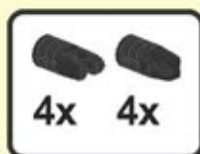
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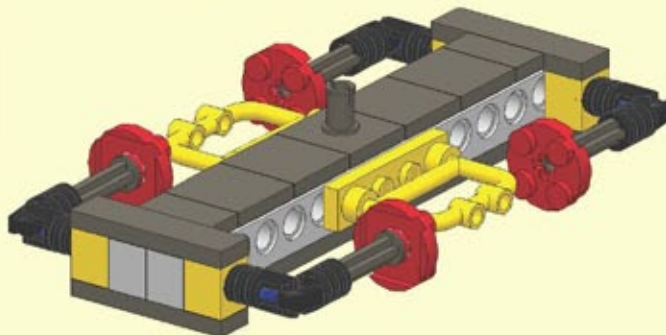
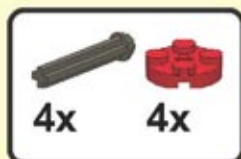
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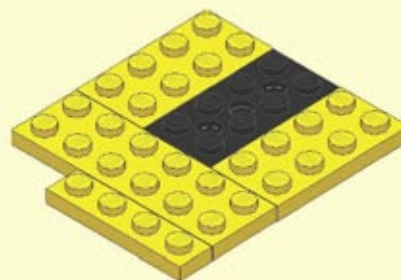
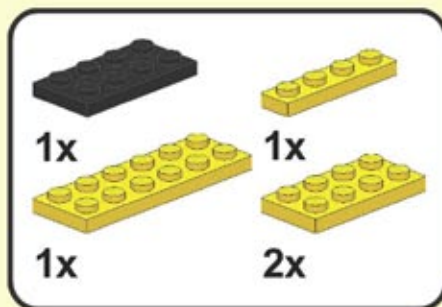
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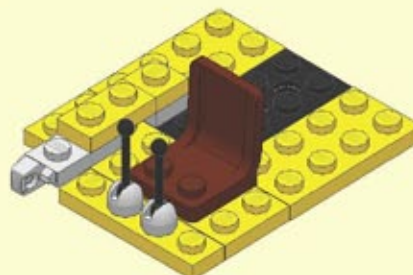
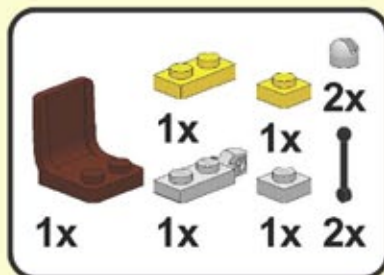
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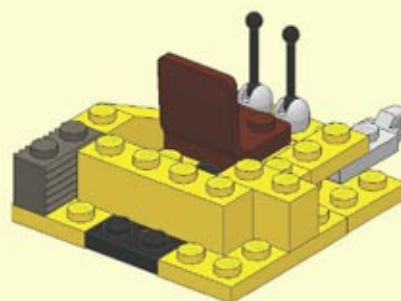
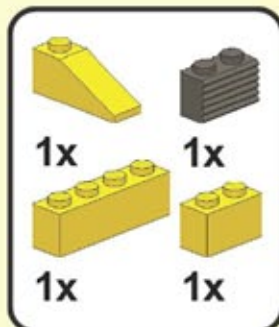
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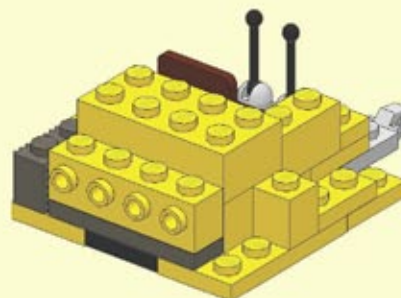
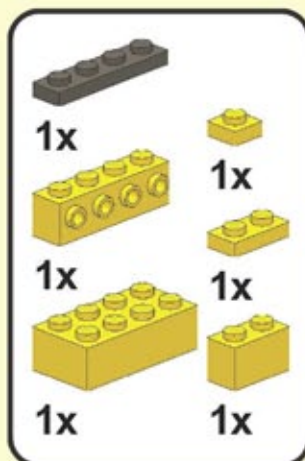
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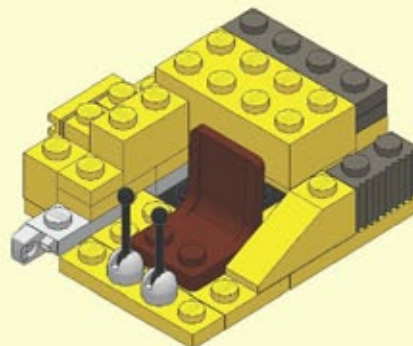
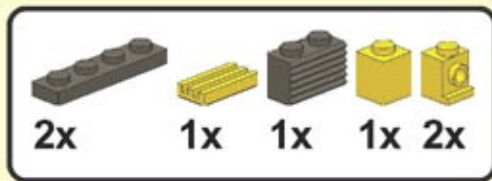
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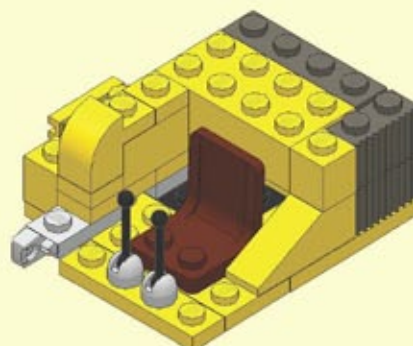
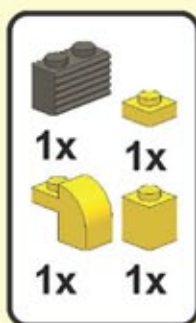
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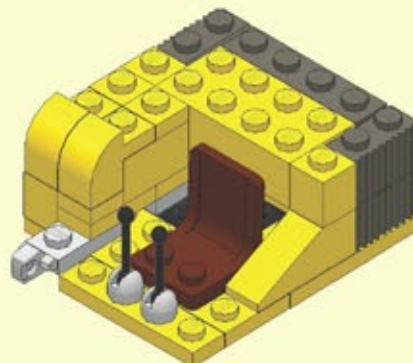
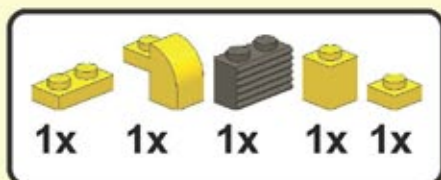
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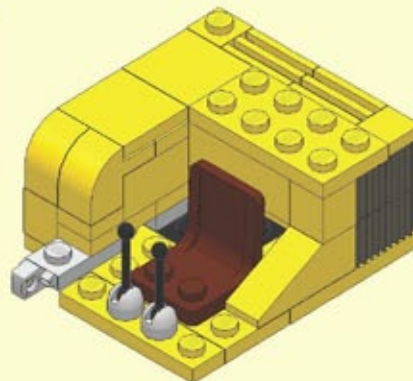
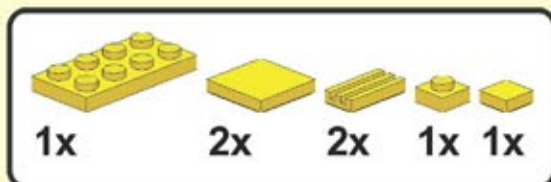
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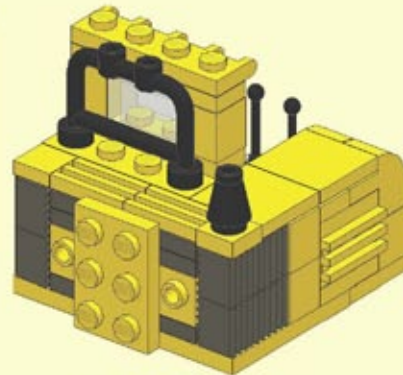
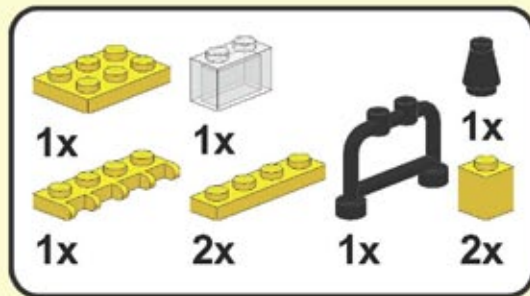
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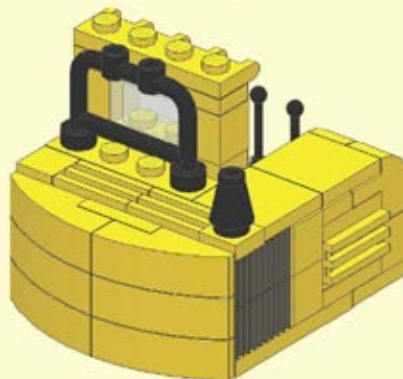
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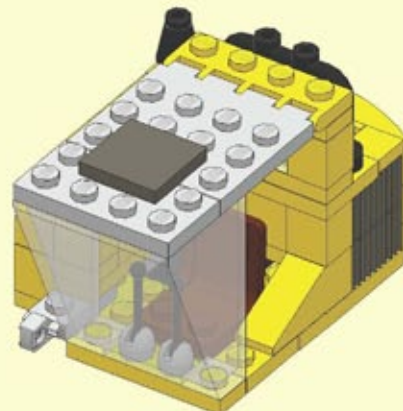
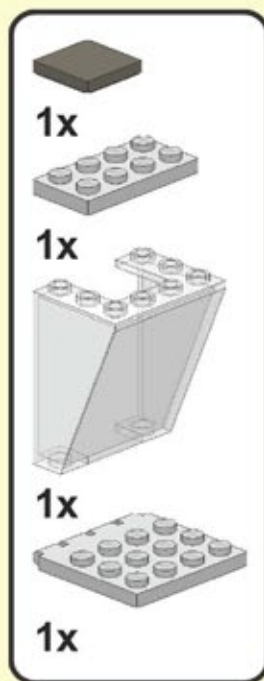
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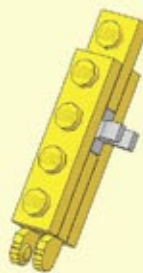
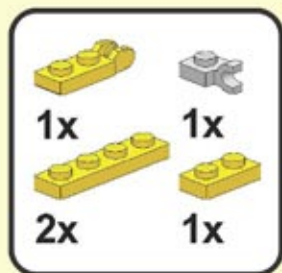
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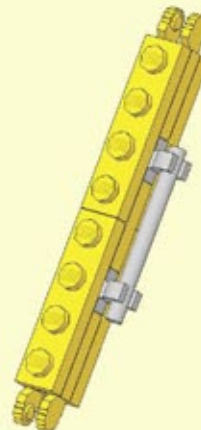
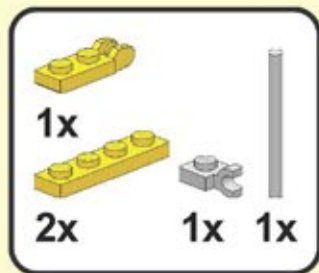
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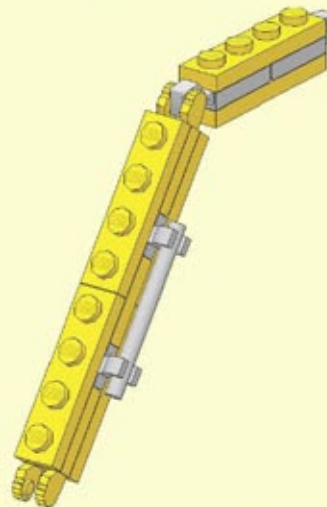
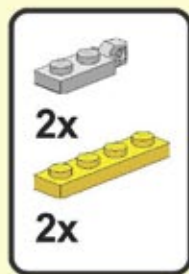
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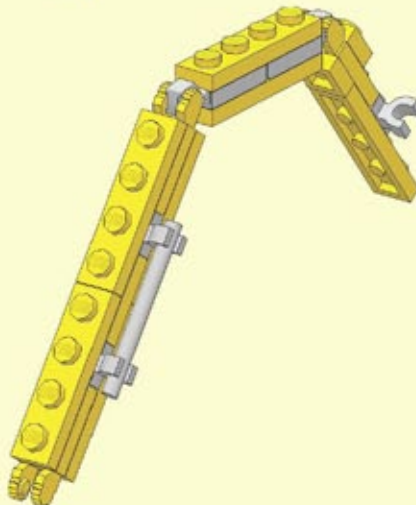
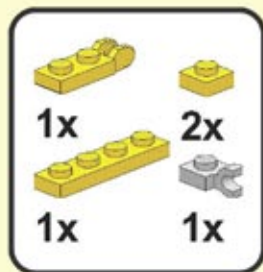
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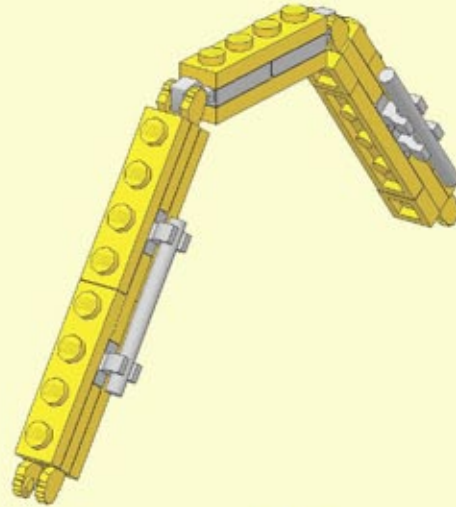
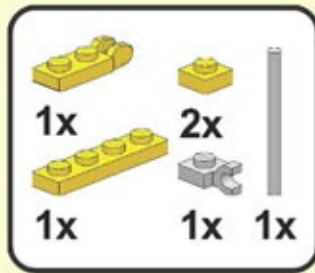
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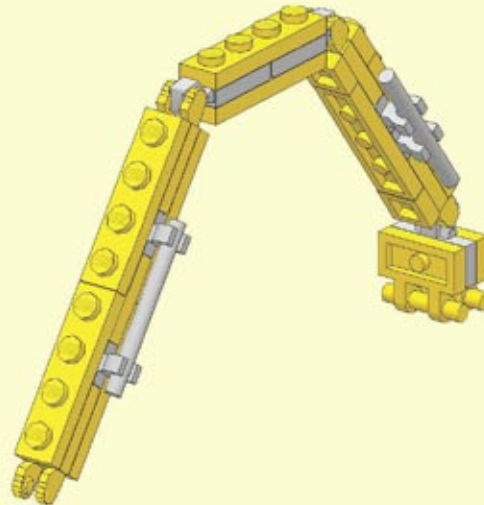
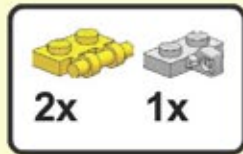
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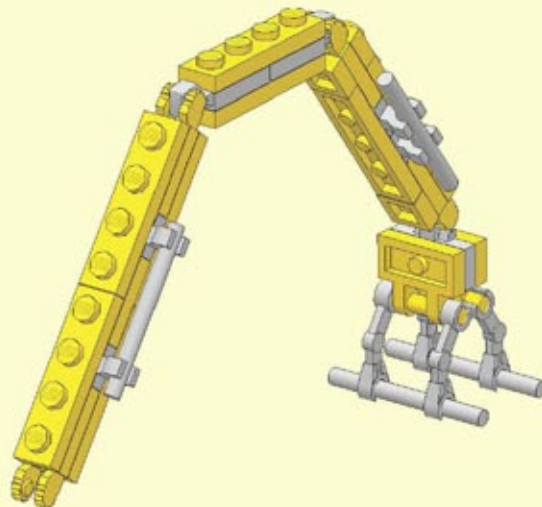
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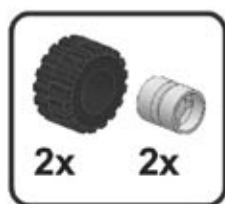


6



7





TRAINSPOTTING



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