From 102 to 915 million combinations

Mathematics Professor Søren Eilers proves that there are many more ways of combining six LEGO bricks of the same colour than we have been suggesting.

Trine Nissen
Corporate Communications

When people visit the LEGO Company, one of the things they are told is that there are 102,981,500 possible ways to combine six eight-stud LEGO bricks of the same colour. People have been given that information for years – and normally no one questions the statement. Now one man has: Søren Eilers, a mathematics professor at the University of Copenhagen, after a visit to LEGOLAND.

"I remembered seeing an old poster stating that there were approx. 102 million ways of combining six LEGO bricks of the same colour. After my visit to LEGOLAND I began wondering how that figure had been arrived at – because to my mind it would be difficult to calculate without a computer."

915,103,765 possibilities

So Søren Eilers began to do his sums – and soon discovered that in fact there are many more combinations than the 102 million. The precise number is 915,103,765 possibilities. He points out: "In the original method of calculation, the only possibilities counted were the ones that eventually produce a column six bricks high. But that actually conceals the many more options of the LEGO brick. Because, of course, you can build the six bricks sideways – for example – to a height of three bricks. But that makes it much more difficult to compute the possible combinations."

Once Prof. Eiler's mathematical curiosity had been aroused, he was determined to find out how many combinations were possible. He approached the problem by writing a special computer programme in Java, a programming language, which tested all the many options: "My home computer was put to a hard test. For a whole week it just stood there, chewing over the data, before eventually producing the final result – which is a much bigger number than the original."

Three maths generations agree

To be absolutely certain that the result was correct, Søren Eilers passed on the problem to a high school student who had been asking him for a challenging mathematical project. A couple of weeks later the teenager returned – with exactly the same result that Prof. Eilers had found. So the Danish professor is no longer in any doubt: "Computers don't make mistakes – it is the person programming them who may make a mistake. As two independent persons have arrived at the same result, we can safely assume that it is the correct one."

But Søren Eilers is not the only maths expert to have wondered about the 102 million possibilities. Rather incredibly, during the same week that Søren Eilers contacted us, Corporate Communications received an e-mail from Muhammad Ahsan, a retired professor of mathematics in Bangladesh. Prof. Ahsan had been on an exchange visit to Denmark via the Rotary organisation and had come across the figure of 102 million. After making a few computations on a sheet of paper, he found that the minimum figure was more than 200 million.

So the conclusion is simple: it's time to get the correcting fluid and eraser out.

Photo: Claus Eggers Sørensen

I still don't think I have found a mathematical solution to the problem – because I used a computer. And that's actually cheating! I would far rather have developed a beautiful formula, says Mathematics Professor Søren Eilers.

In 1974 Jørgen Kirk Kristiansen – a cousin of the present owner of the LEGO Company, Kjeld Kirk Kristiansen – who worked in the LEGO Laboratory, calculated the number that has since been quoted far and wide. For the record, however, it should be pointed out that Jørgen Kirk Kristiansen expressly stated that he had "taken into account only the combinations that were possible when you build eight-stud bricks singly on top of each other – not when you also build out to the sides.

(Source: Klodshans, the Danish-language Company magazine, May 1974)

There's a big difference between building only a model six bricks high …

… and including all the possibilities you get when you build a structure sideways, for instance three bricks high.