

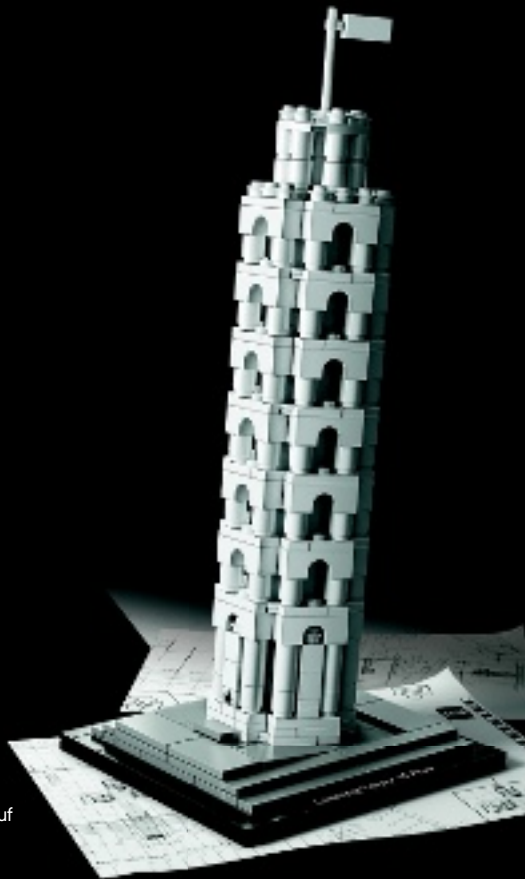









# Architecture

## The Leaning Tower of Pisa

Torre pendente di Pisa

Pisa, Italy



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-  Folheto disponível em português em
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# The Leaning Tower of Pisa

The Leaning Tower of Pisa (Torre pendente di Pisa) took almost 200 years to complete and has stood beside the Cathedral of Pisa for over 600 years. Thanks to its famous tilt, it has become one of the world's most recognizable architectural landmarks. The story behind the bell tower spans over 800 years of European history and provides a fascinating glimpse into a miracle of medieval engineering.

## Torre pendente di Pisa

La costruzione della torre di Pisa ha richiesto quasi 200 anni. Il famoso campanile occupa la sua posizione, accanto alla Cattedrale, da oltre 600 anni. Grazie alla sua celebre inclinazione, è diventato uno dei simboli architettonici più riconoscibili al mondo. Gli 800 anni di storia della torre sono un affascinante resoconto degli eventi europei che hanno portato alla realizzazione di questo esempio di miracolosa ingegneria medievale.



# History

The story of the tower of Pisa begins in January 1172 when the widow Berta of Bernado left 60 soldi (gold coins) in her will to purchase stones for the construction of a bell tower. A year later, in August 1173, the first foundations for the tower were laid in the ground behind the existing Pisa Cathedral.

At that time, Pisa was a rich, independent trading port and it was hoped that the new tower would become a symbol of a city at the height of its cultural and economic power. Therefore the circular, freestanding tower was designed to be one of the tallest in Europe and included finely elaborately carved columns and intricate bas-reliefs.

Within five years, and with only two floors completed, the builders faced a serious obstacle – a combination of shallow foundations and soft, unstable subsoil was causing the tower to lean. Construction was stopped, and with Pisa's prosperity and power on the decline, a hundred years would pass before building was resumed. Four more floors were added in 1272, the seventh floor in 1319 and the bell-chamber in 1372. On completion, the tower would stand 185 ft. (56.4 m) tall and consist of eight stories, including the bell-chamber. A total of seven bells, one for each note of the musical scale, were installed – adding even more weight to the already heavy structure. Throughout the construction period, and especially during the last one hundred years, many have tried to solve the tower's overriding structural problem, more often than not, making

the problem worse. It would be 2008 before engineers could confirm that the tower had stopped moving for the first time in its history.

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# Storia

La storia della torre di Pisa inizia nel gennaio 1172 quando la vedova Berta di Bernardo lasciò nel suo testamento 60 “soldi” (monete d'oro) per l'acquisto di pietre per la costruzione di un campanile. Un anno dopo, nell'agosto del 1173, le prime fondamenta della torre furono gettate nell'area alle spalle della Cattedrale di Santa Maria Assunta, già edificata.

A quel tempo, Pisa era un ricco porto commerciale indipendente e si sperava che la nuova torre sarebbe diventato il simbolo di una città al culmine del suo potere culturale ed economico. Pertanto, la torre circolare, a se stante, fu progettata per essere una delle più alte in Europa e includeva colonne finemente intagliate e intricati bassorilievi.

Dopo cinque anni, e con solo due ordini (piani) completati, gli architetti si trovarono di fronte a un serio problema: la combinazione di fondazioni insufficientemente profonde e di un sottosuolo molle e instabile aveva causato l'inclinazione dell'edificio. I lavori furono sospesi, proprio quando la prosperità e il potere di Pisa iniziava a declinare, e furono ripresi solo un centinaio di anni dopo. Quattro nuovi ordini furono aggiunti nel 1272, il settimo ordine nel 1319 e la cella campanaria nel 1372. Al suo completamento, la torre misurava 56,4 m di altezza e aveva otto ordini, incluso la cella campanaria. Sette campane, una per ogni nota della scala musicale, furono installate, aggiungendo ancora più peso a una struttura già precaria. Per tutto il periodo di costruzione, e in particolare nel corso degli ultimi cento anni, in molti hanno provato a risolvere il complesso problema strutturale della torre, peggiorando spesso la situazione. Fu solo nel 2008 che gli ingegneri furono in grado di stabilire che l'inclinazione graduale della torre si era arrestata per la prima volta nella sua storia.

# Construction

While the Tower of Pisa is most known for “leaning”, it would still be a remarkable architectural structure without this famous feature. Constructed at a time when there was very little building of this kind being carried out in Europe, the intelligent use of columns and arches demonstrates an in-depth understanding of weight and load characteristics that was way ahead of its time.

What the architect overlooked however, was the clay-based soil and the need for a foundation capable of supporting a bell tower that would eventually weigh 16,000 tons (14,500 metric tons).

The eight-story tower was built with limestone and lime mortar, with an exterior covering of marble. Interestingly, the limestone is probably why the tower has not cracked and collapsed – the rock is flexible enough to withstand the pressures placed on it by the tilt. The bottom story of the tower is an arcade of 15 closed marble arches. Each of the following six stories contains 30 arches, while the final story, or bell-chamber, has 16 arches.



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# La costruzione

Sebbene la torre di Pisa sia famosa per la sua “pendenza”, il campanile sarebbe una notevole struttura architettonica anche senza questa famosa caratteristica. Costruita in un periodo in cui pochi progetti di questo tipo venivano realizzati in Europa, l'uso intelligente delle colonne e degli archi dimostra una vera comprensione di caratteristiche quali peso e carico, decisamente all'avanguardia per i tempi.

Quello di cui gli architetti non tennero conto, tuttavia, fu che, a causa del terreno argilloso e del peso finale di 14.500 tonnellate, la torre necessitava di adeguate fondamenta.

Il campanile di otto ordini fu costruito con pietra calcarea e malta di calce, con un rivestimento esterno di marmo. È interessante notare che l'uso del calcare è probabilmente la ragione per cui la torre non è crollata, in quanto questo tipo di roccia è dotata della flessibilità necessaria per resistere alle pressioni esercitate su di essa dall'inclinazione. L'ordine basamentale della torre è una “sala” formata da un loggiato chiuso con 15 archi di marmo. Ciascuno dei sei ordini successivi contiene 30 archi, mentre l'ordine finale, o cella campanaria, ne contiene 16.



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Many of the attempts to rectify the tower's leaning are just as interesting as the actual construction itself. After work resumed on the tower in 1272, engineers attempted to compensate for the tilt by building the upper floors with one side taller than the other. However, the weight of the extra floors caused the edifice to sink further and lean more.

In 1934, 362 holes were drilled in the base of the tower and filled with 99 tons (90 metric tons) of cement, with almost disastrous consequences. In the early 1990s, the tower was closed to the public and engineers anchored the tower to the ground using high tensile steel cable in an attempt to stabilize it. After two decades of corrective reconstruction and stabilization efforts, it was announced in 2008 that the tower had been stabilized to such a degree that it had actually stopped moving for the first time in its history. It is now claimed that the tower will remain stable for at least 200 years.

Prior to this final restoration work, the tower leaned at an angle of 5.5 degrees. It now leans at 3.99 degrees. This means that the top of the tower is displaced horizontally by 12 ft. 10 in (3.9 m).



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Molti dei tentativi di correggere la pendenza della torre sono altrettanto interessanti quanto la storia della costruzione dell'edificio. Quando i lavori della torre ripresero nel 1272, gli ingegneri tentarono di correggere l'inclinazione costruendo gli ordini superiori con un lato più alto. Tuttavia, il peso degli ordini aggiuntivi causò un ulteriore affondamento e pendenza dell'edificio.

Nel 1934, 362 fori furono praticati nella base della torre e riempiti con 90 tonnellate di cemento, con conseguenze quasi disastrose. All'inizio degli anni '90, la torre fu chiusa al pubblico per consentire agli ingegneri di installare tiranti di acciaio per ancorare l'edificio al suolo nel tentativo di stabilizzarla. Dopo due decenni di ricostruzione correttiva e tentativi di consolidamento, nel 2008 fu annunciato che la torre era stata stabilizzata e che per la prima volta nella sua storia l'inclinazione si era arrestata. Gli ingegneri sostengono che il campanile rimarrà stabile per almeno altri 200 anni.

Prima di questi interventi di restauro, l'angolo di pendenza della torre era di 5,5 gradi. La pendenza attuale è di 3,99 gradi. Questo significa che lo spostamento orizzontale dalla sommità dell'asse alla base è di 3,9 m.

# Today

The Leaning Tower of Pisa remains an iconic architectural landmark and a true feat of medieval engineering. Though more famous for its tilt, the true wonder of the tower is that it still stands after 800 years.

In 1987, the entire Piazza del Duomo (Cathedral Square) – also known as Piazza Dei Miracoli (Field of Miracles) – including the tower as well as, the Cathedral, and baptistery was declared a Unesco World Heritage Site. This was an acknowledgement of the unique nature of the site and its importance as one of Italy's most popular tourist attractions.



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## Architects

The identity of the Tower of Pisa's first architect remains a mystery. For many years, the initial phase of the design work was attributed to Bonanno Pisano, a well-known 12th-century resident artist of Pisa. However, recent studies appear to indicate that an architect named Diotisalvi, who designed the baptistery, was also responsible for the tower.

The second phase of construction is attributed to Giovanni di Simone, who added four floors to the tower in 1275. Architect Tommaso di Andrea Pisano (1350-1372) was the architect who finished the work and succeeded in harmonizing the Gothic elements of the bell-chamber with the Romanesque style of the tower.

# Oggi

La torre pendente di Pisa rimane un iconico simbolo architettonico, un trionfo dell'ingegneria medievale. Sebbene sia più famosa per la sua inclinazione, la vera meraviglia della torre è la sua longevità: ben 800 anni.

Nel 1987, l'intera Piazza del Duomo, o Piazza dei Miracoli, con la torre, il duomo e il battistero, è stata dichiarata patrimonio dell'umanità dall'UNESCO. Questo è un riconoscimento della natura unica del sito e della sua importanza nelle vesti di una delle attrazioni turistiche più visitate d'Italia.

## Architetti

La vera identità del primo architetto della torre di Pisa rimane un mistero. Per molti anni, la fase iniziale del lavoro di progettazione fu attribuito a Bonanno Pisano, un noto artista pisano del 12° secolo. Tuttavia, studi recenti attribuiscono la paternità della torre a un architetto di nome Diotalvi, il quale progettò il battistero, sul lato opposto della cattedrale.

La seconda fase di costruzione è più chiara ed è attribuita a Giovanni di Simone, che aggiunse quattro piani nel 1275. I lavori furono portati a termine dall'architetto Tommaso di Andrea Pisano (1350-1372), il quale armonizzò gli elementi gotici della cella campanaria con lo stile romanico della torre.

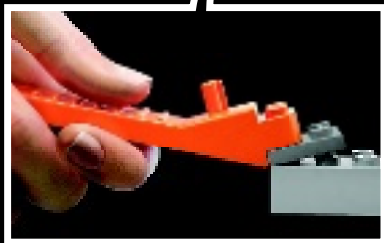
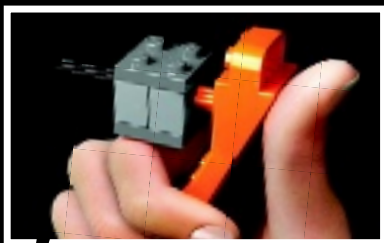
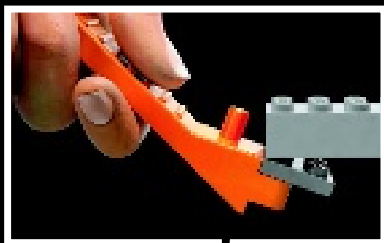
# Facts about The Leaning Tower

Location:	Pisa, Italy
Architects:	Various
Date:	Started 1173 – Completed 1399
Construction type:	Bell Tower
Architectural Style:	Romanesque Tower/Gothic Bell Chamber
Materials:	Limestone, Lime mortar, Marble exterior
Height:	8 stories, 185 ft. (56.4 m)
Diameter of base:	50 ft. 9.6 in (15.484 m)
Weight:	16,000 tons (14,500 metric tons)
Angle of tilt:	3.97 degrees 12 ft. 10 in (3.9 m) from vertical

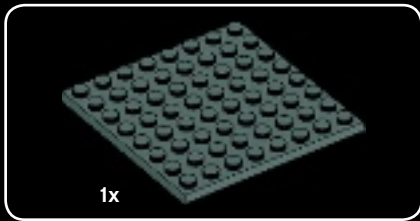
# Alcuni dati sulla torre di Pisa

Ubicazione:	Pisa, Italia
Architetti:	Diversi
Date:	Costruzione iniziata nel 1173 – terminata nel 1399
Tipo di edificio:	Campanile
Stile architettonico:	Torre romanica/cella campanaria gotica
Materiali:	Calcere, malta di calce, rivestimento in marmo
Altezza:	8 ordini (piani), 56,4 m
Diametro della base:	15,484 m
Peso:	14.500 tonnellate
Grado di inclinazione:	3,97 gradi, 3,9 m dall'asse verticale





[LEGO.com/brickseparator](https://LEGO.com/brickseparator)



1



*At only 185 ft. (56.4 m), the Leaning Tower of Pisa is the smallest "tower" to achieve worldwide recognition.*

*Alto solo 56,4 m, il campanile della piazza del duomo di Pisa è la "torre" più piccola ad aver raggiunto una popolarità su scala mondiale.*

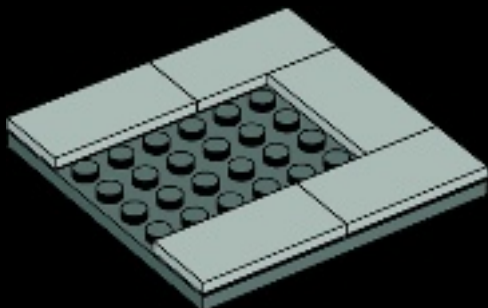


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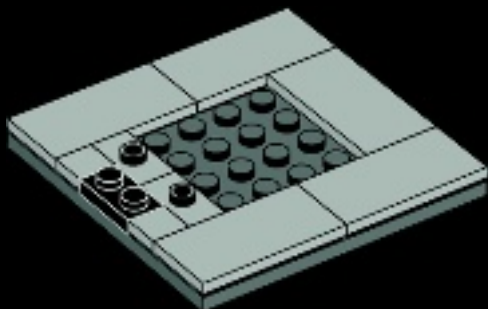


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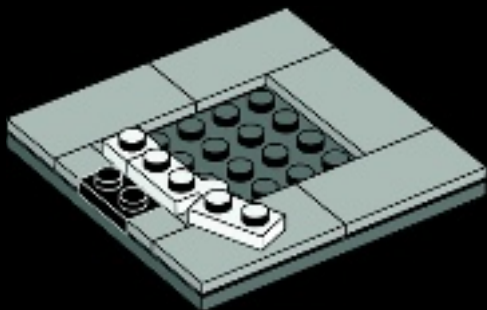


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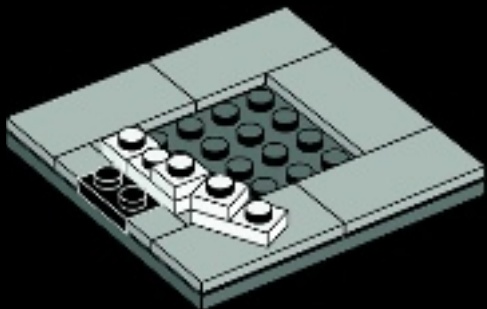
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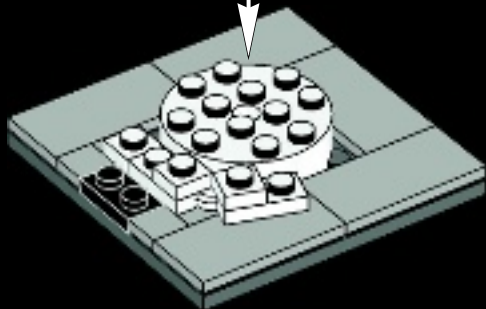
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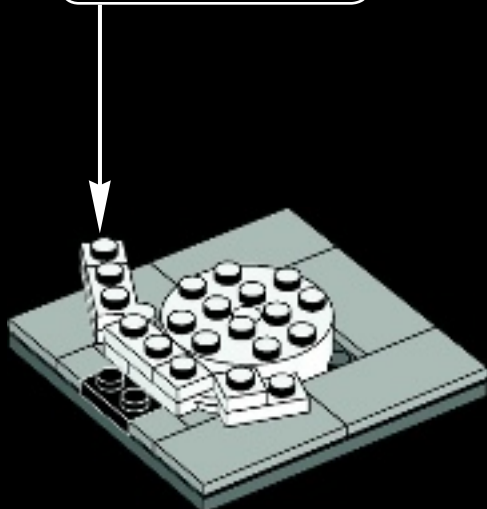
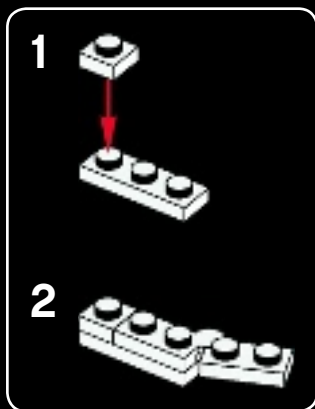
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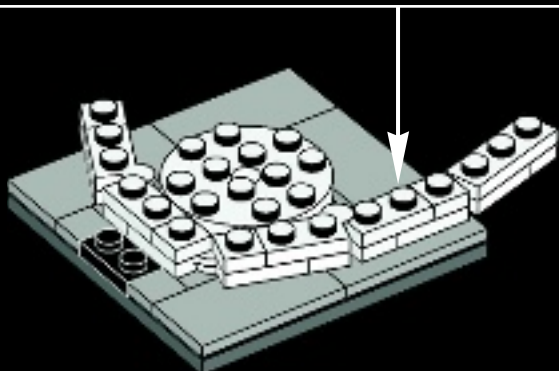
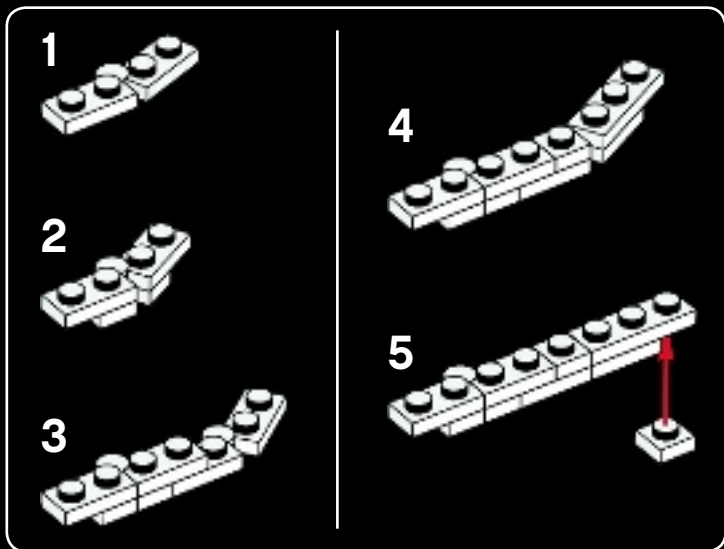


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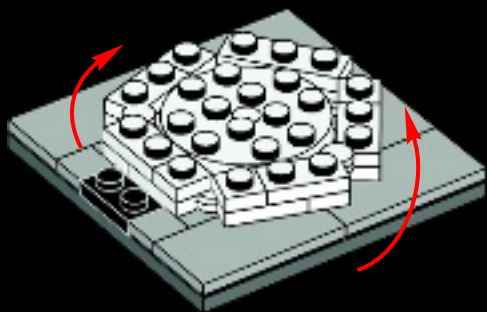




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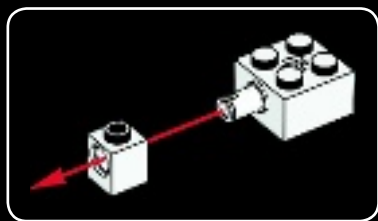


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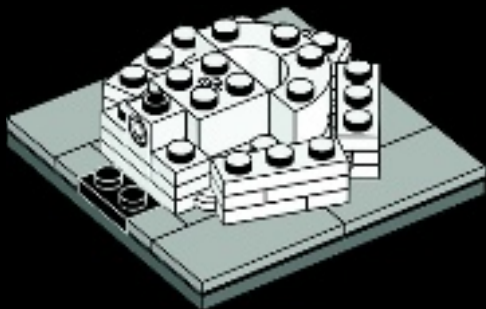






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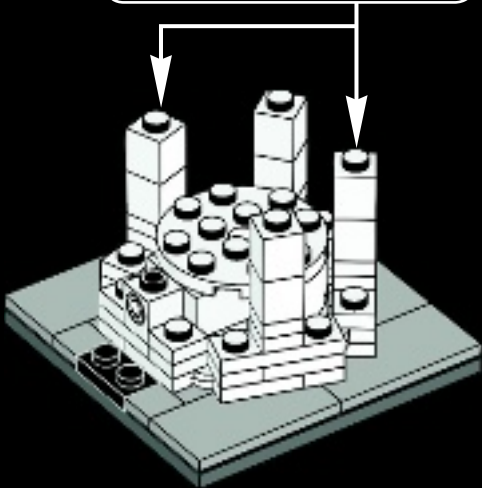
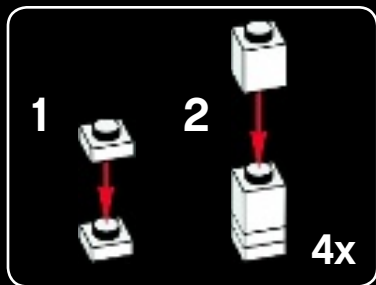


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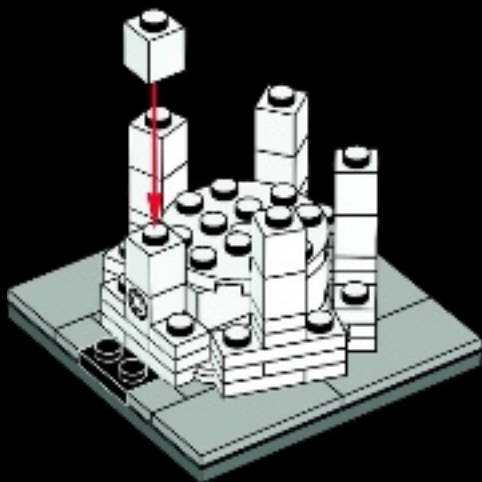
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*The first bell was placed in the tower in 1198.*

*La prima campana fu installata nella torre nel 1198.*

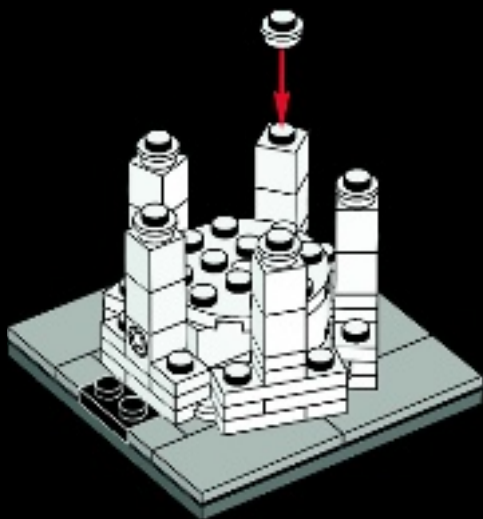


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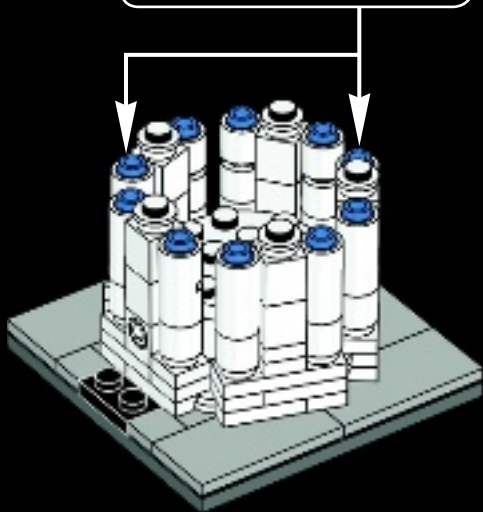
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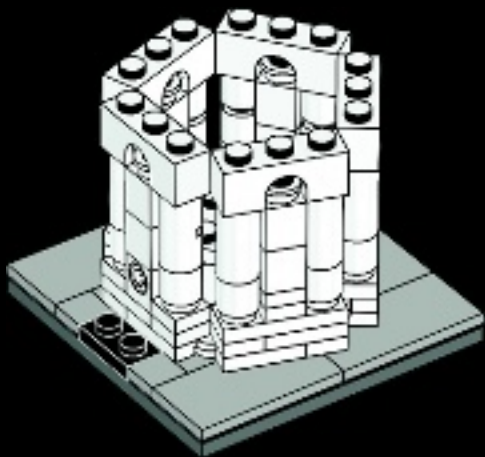
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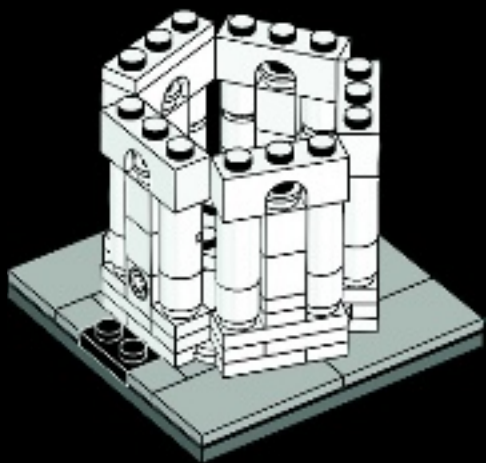
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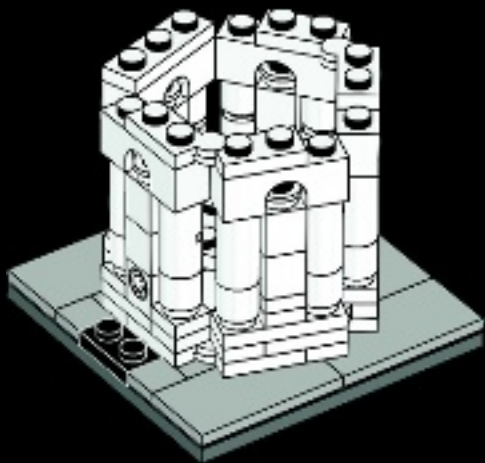
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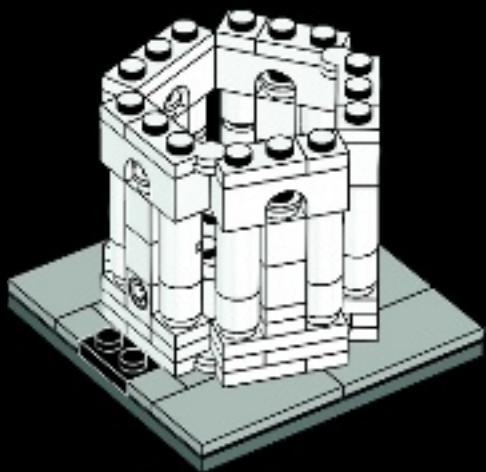






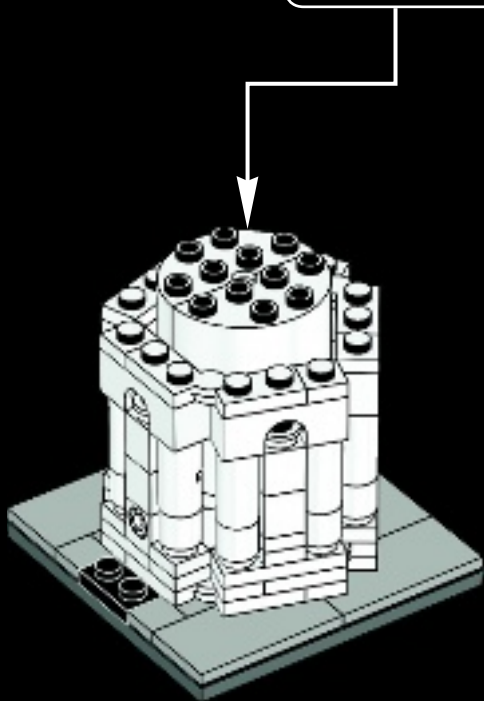
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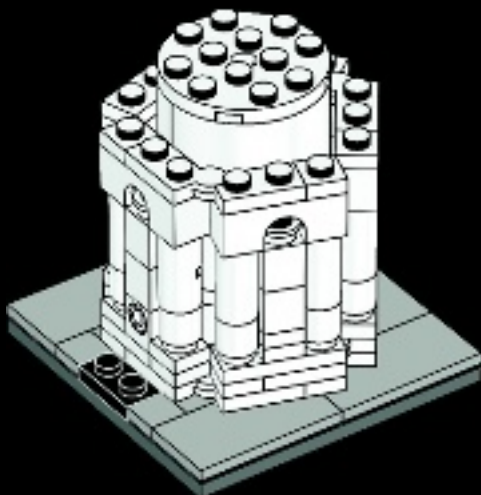
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# 25



*The tower has 296 or 294 steps; the seventh floor has two fewer steps on the north-facing staircase.*

*La torre ha 296 o 294 gradini; la scala rivolta verso nord del settimo ordine ha due gradini in meno.*

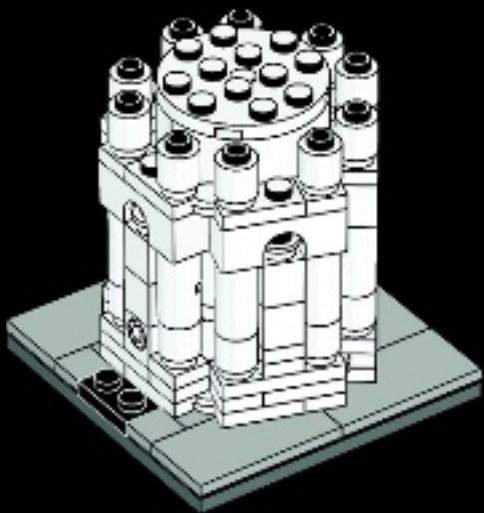


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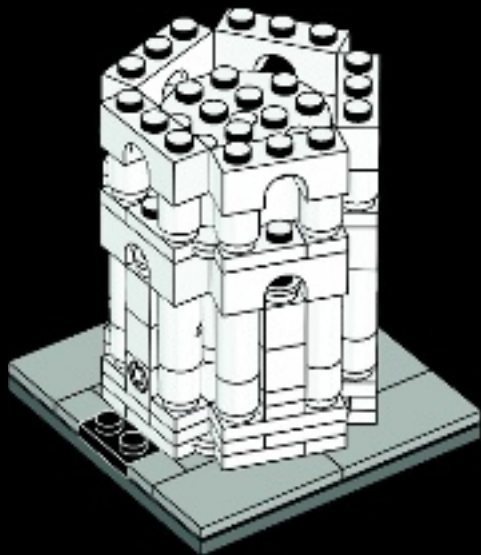
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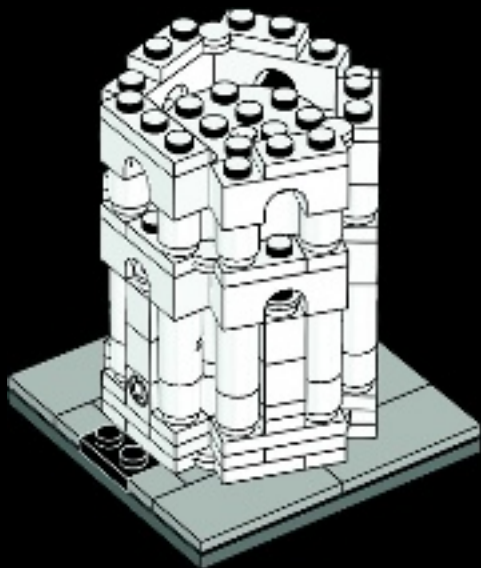


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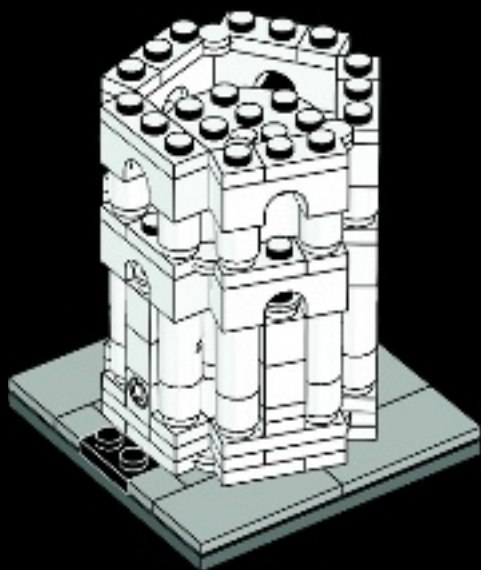
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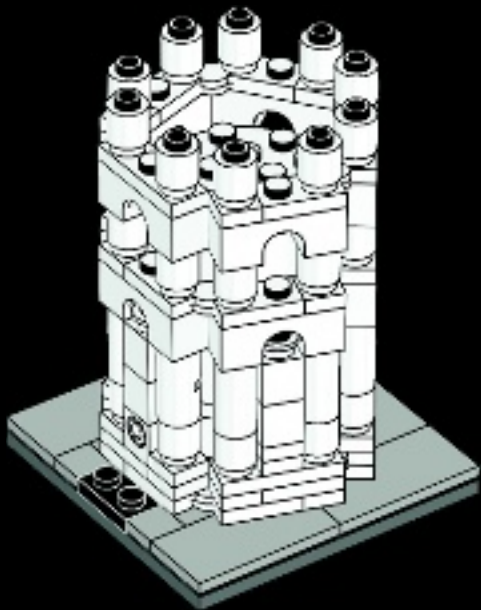
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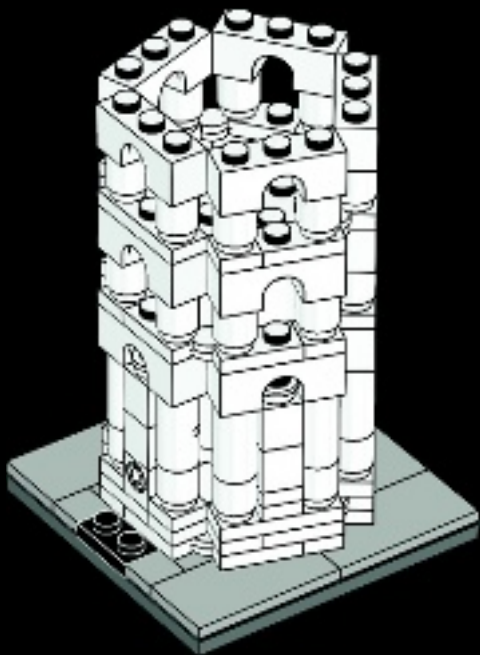






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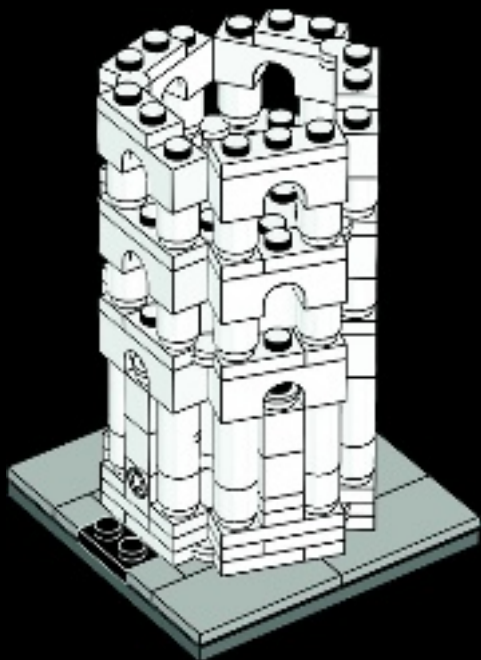


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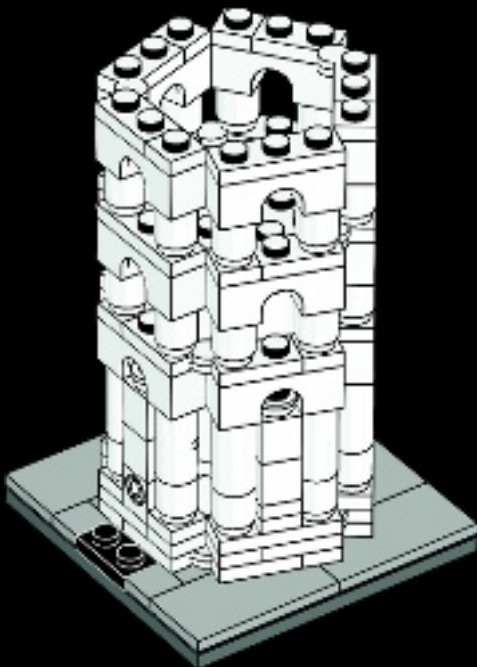
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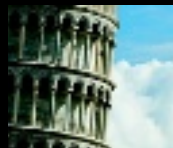
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*There are 207 individual columns ranged around the eight-story tower.*

*Gli otto ordini della torre contengono 207 singole colonne.*

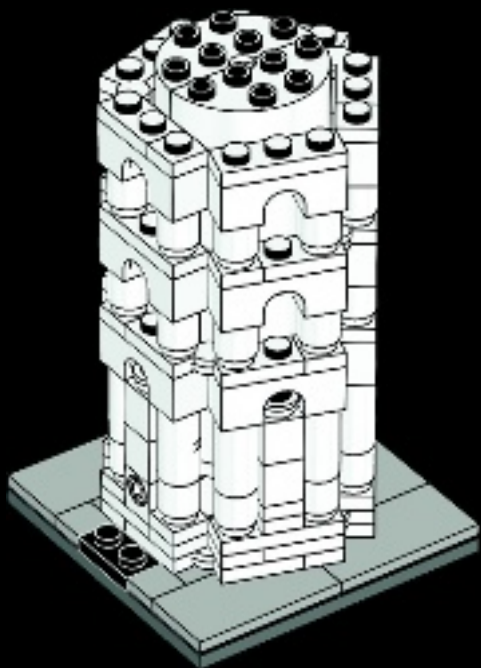


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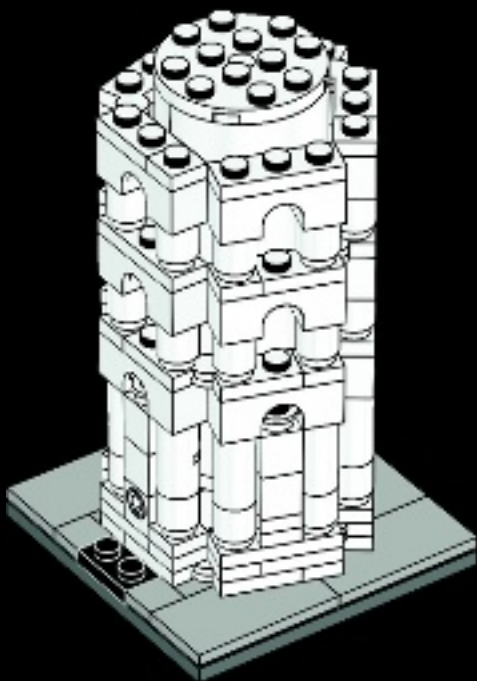
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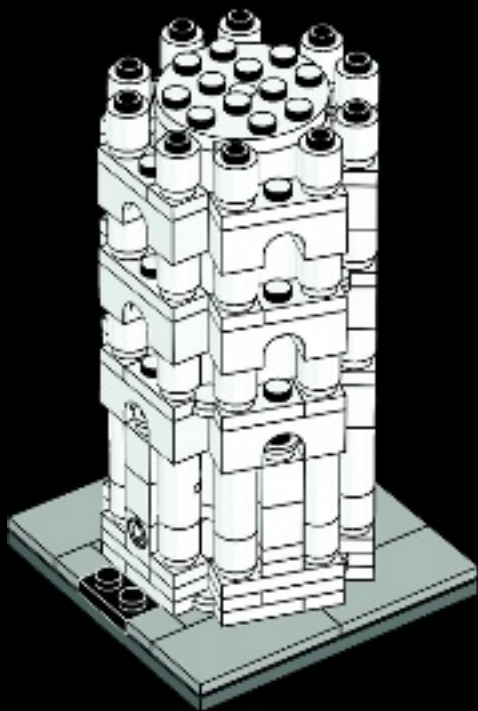
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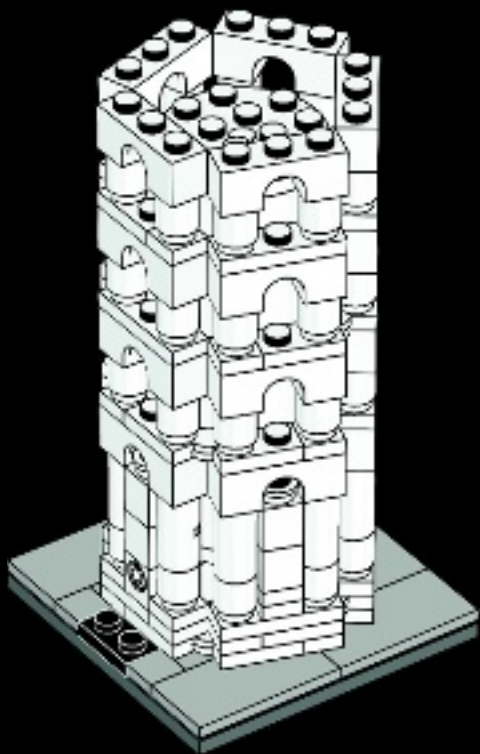
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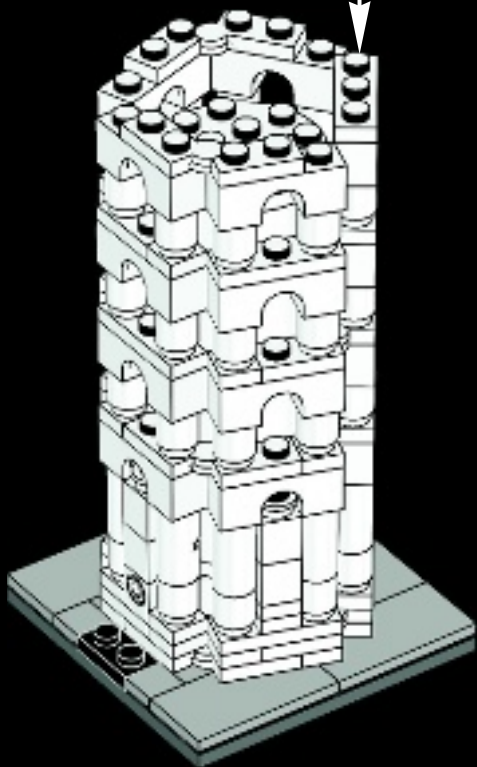
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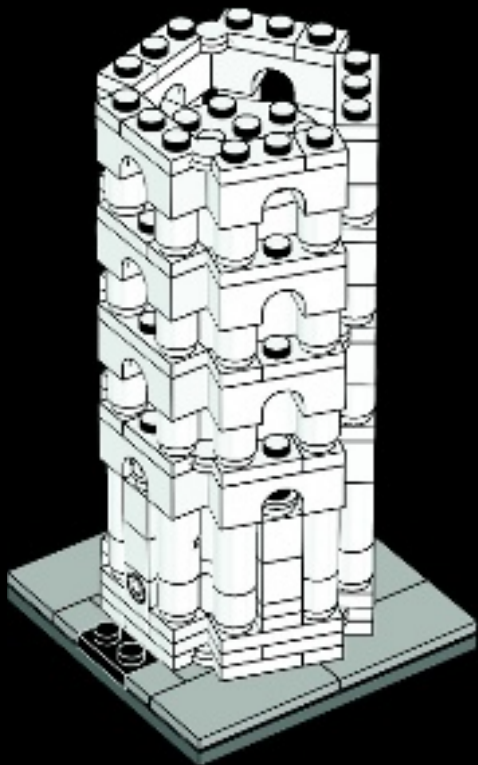






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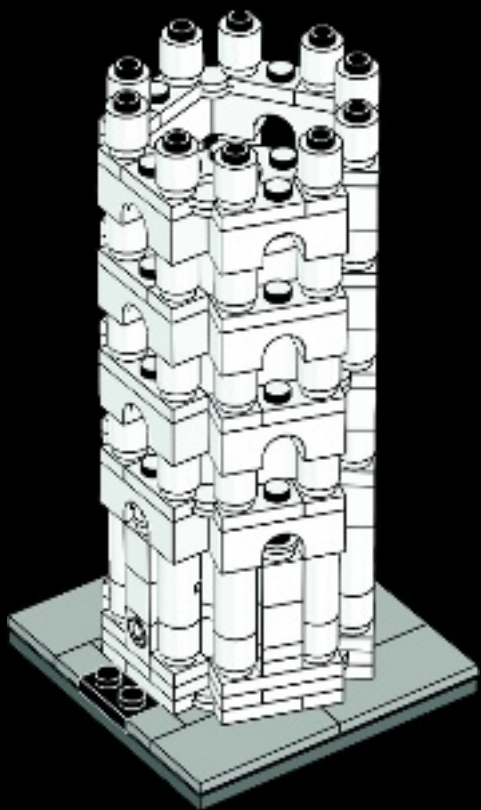
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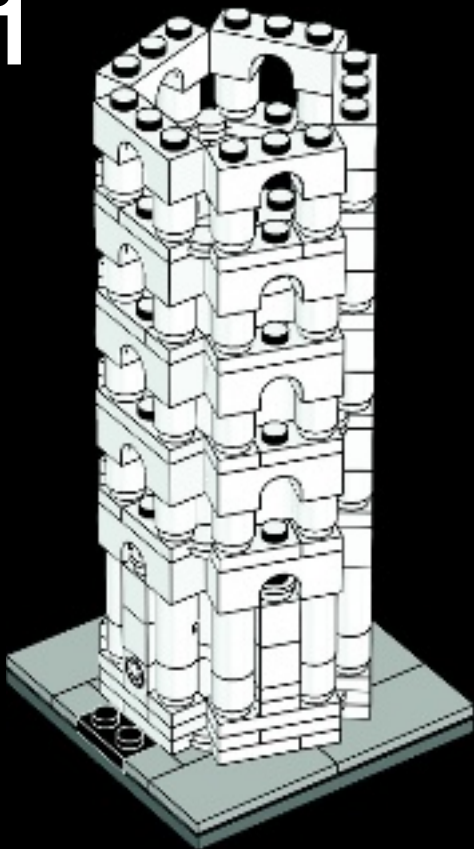
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# 41



*On the upper floors, one side is taller than the other. As a result, the tower is actually curved.*

*Un lato degli ordini superiori è più alto dell'altro. La torre è quindi leggermente arcuata.*



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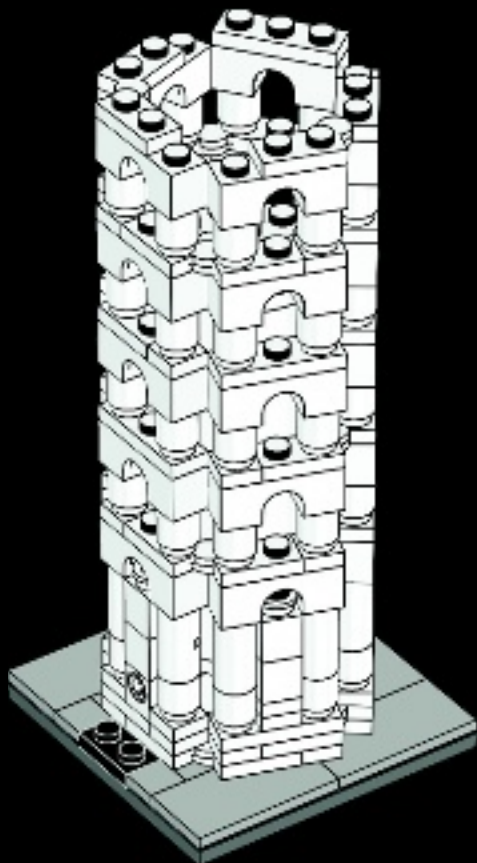


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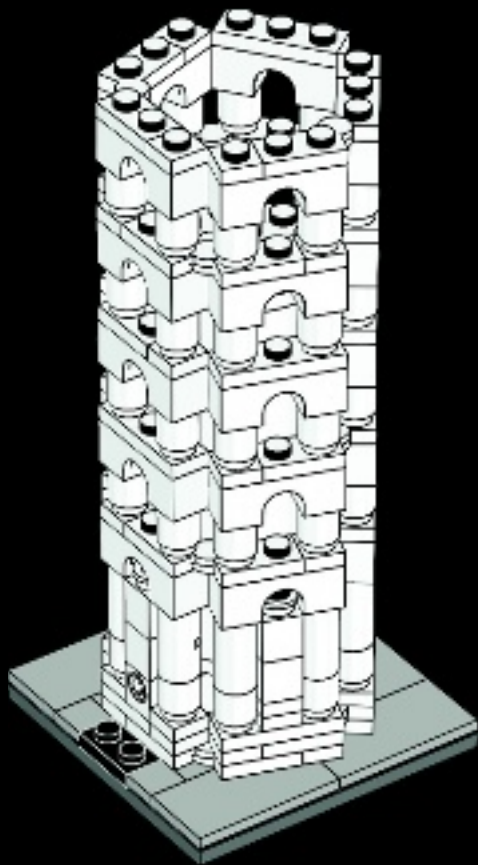
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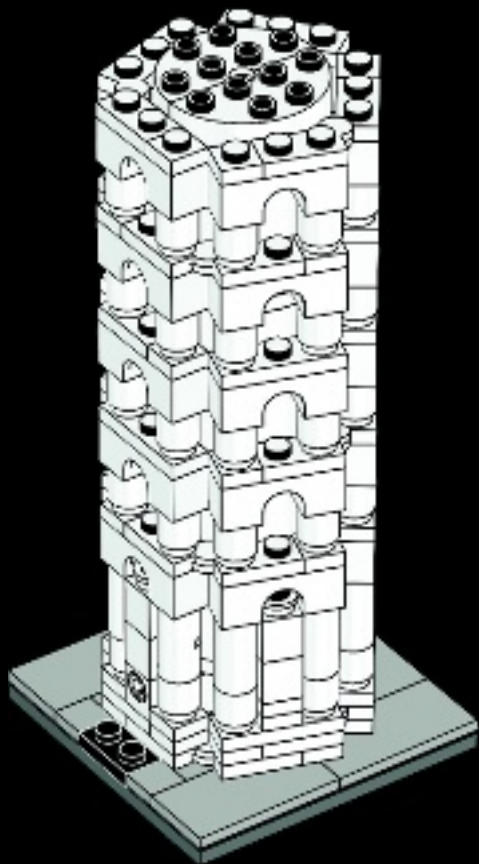
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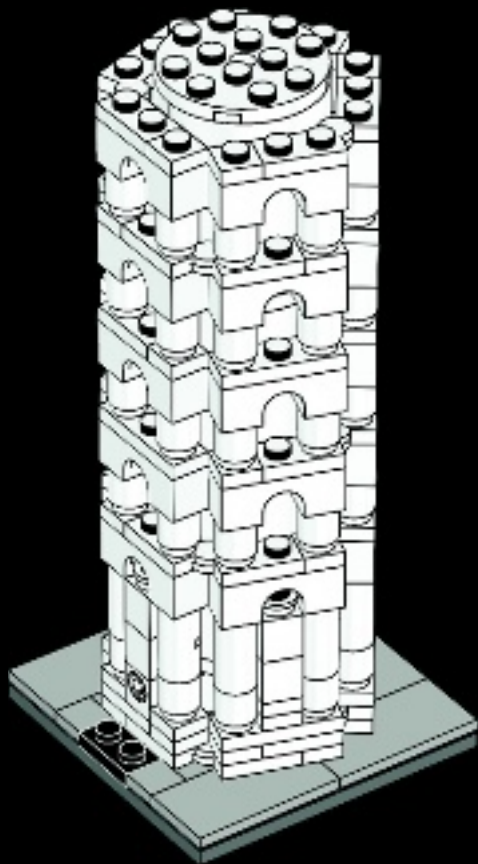
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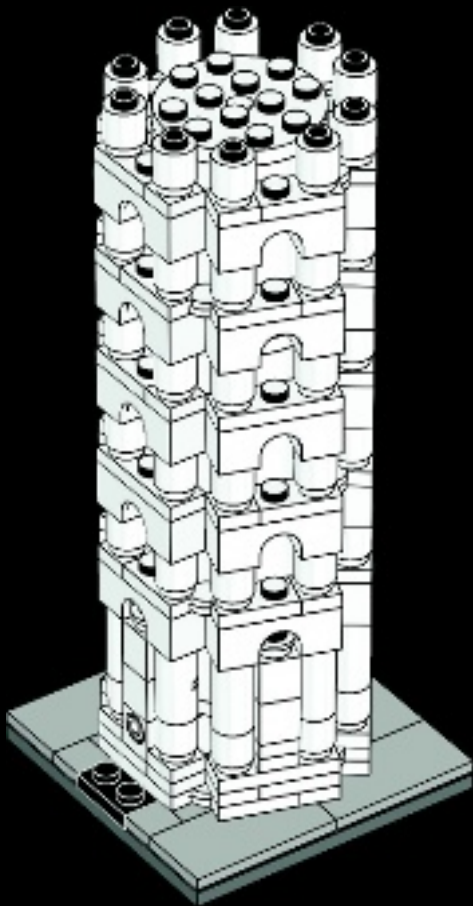
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10x

# 46

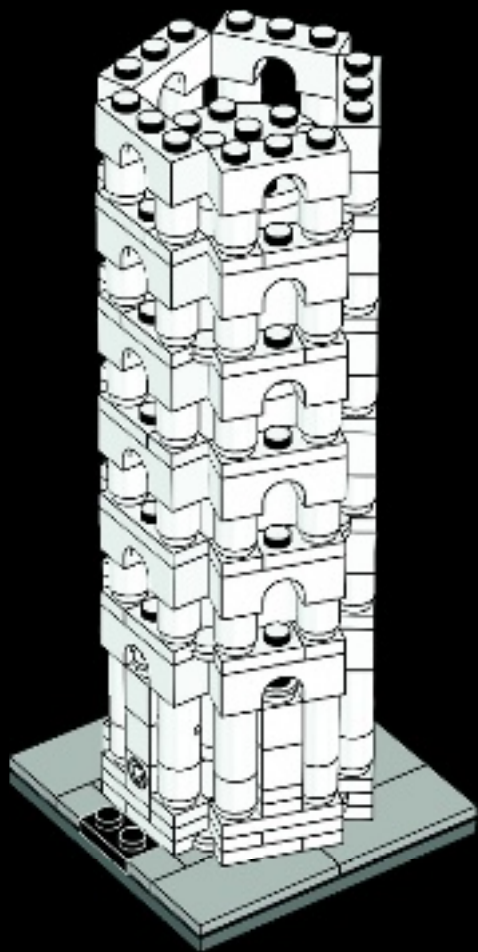






5x

# 47



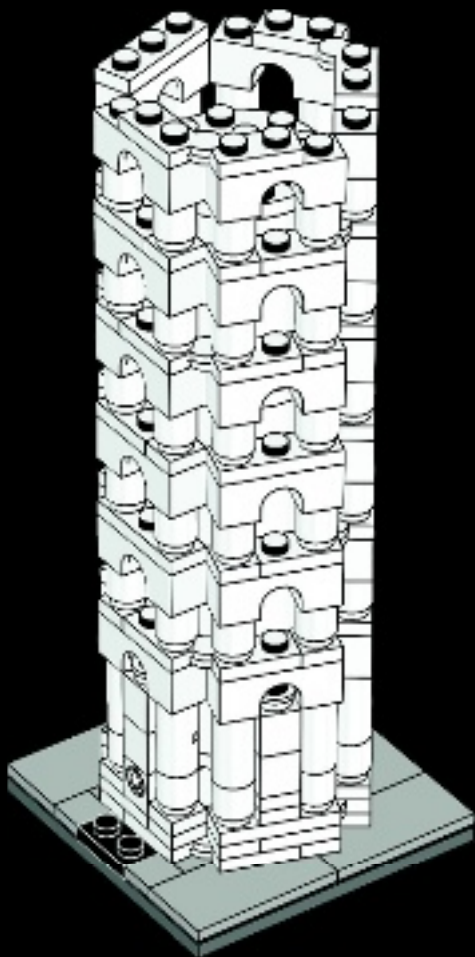


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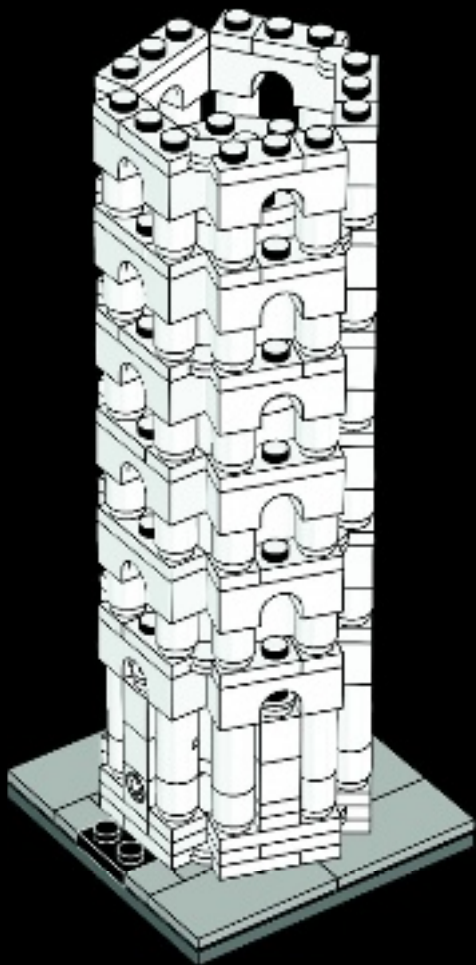
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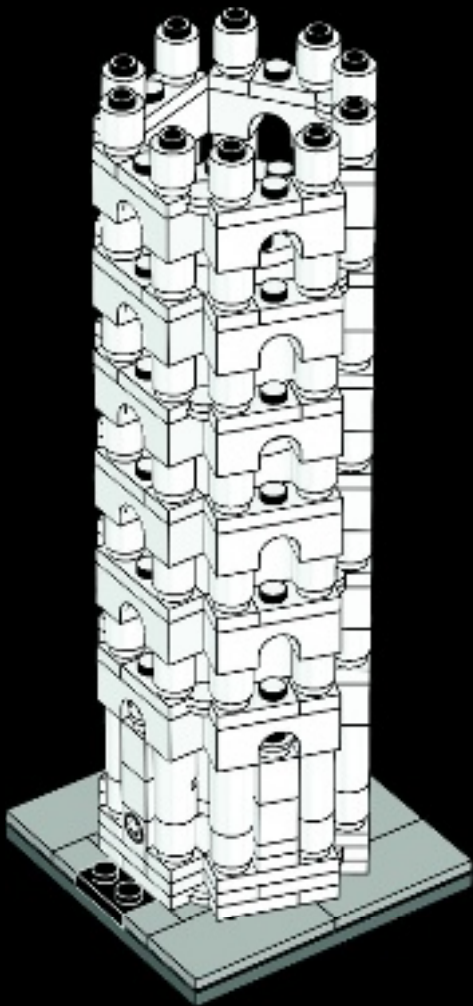
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10x

# 50

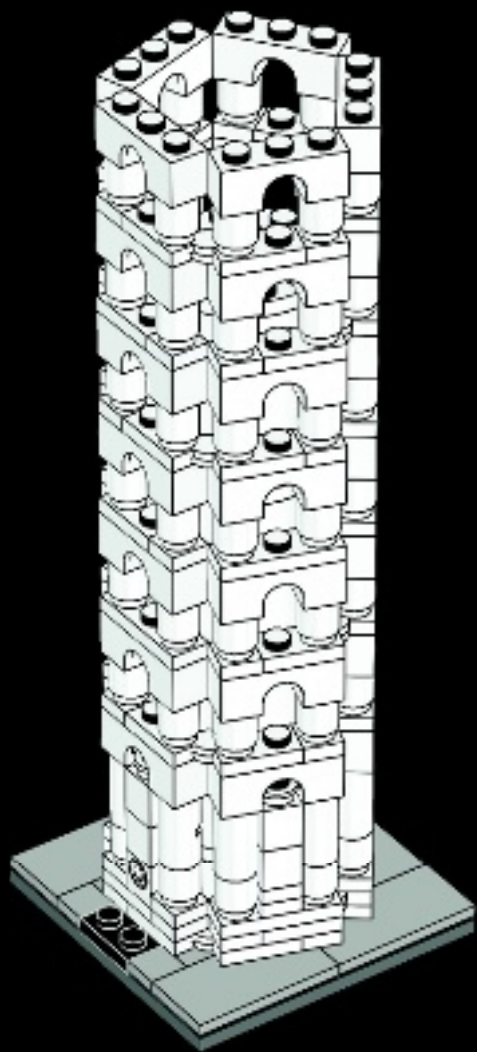


60



5x

51



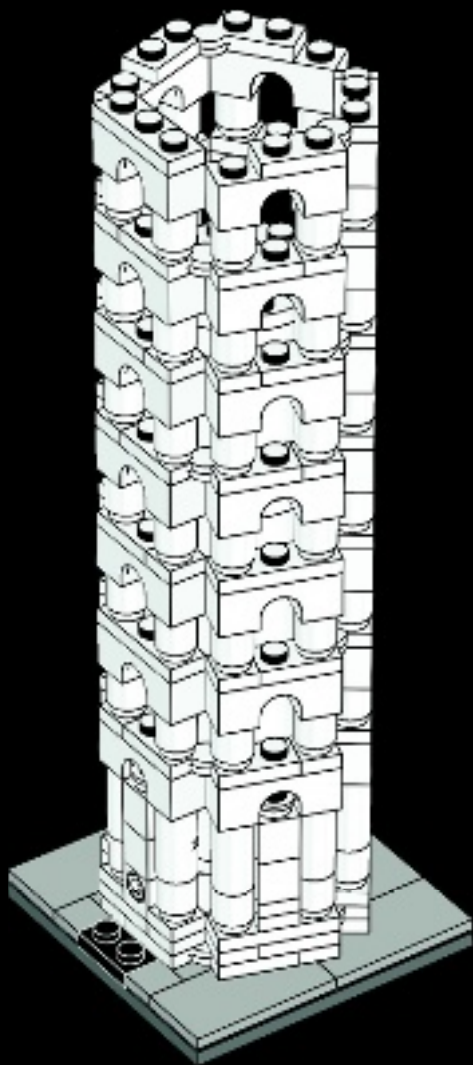


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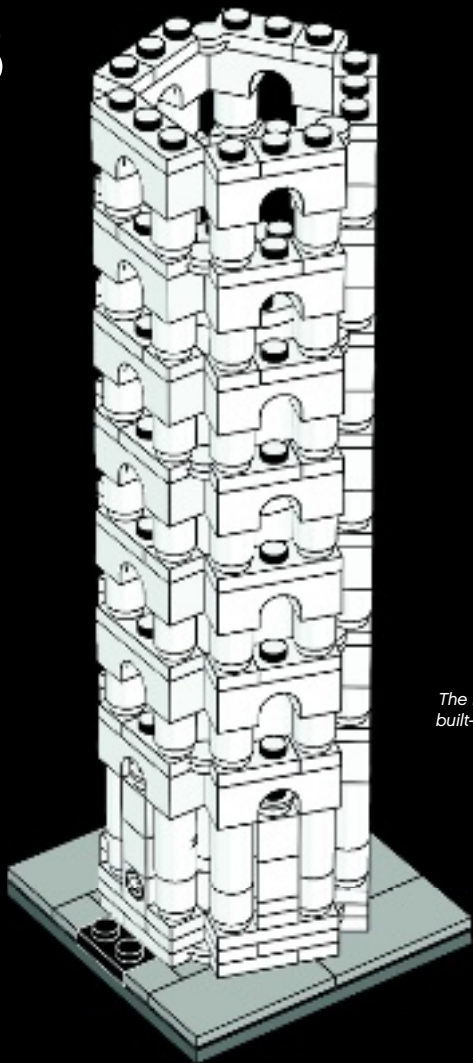
# 52





4x

# 53



*The bell-chamber incorporates a built-in 5.5 in (14 cm) correction in relation to the tower's lean.*

*La pendenza della cella campanaria è stata corretta di 14 cm rispetto all'inclinazione complessiva della torre.*

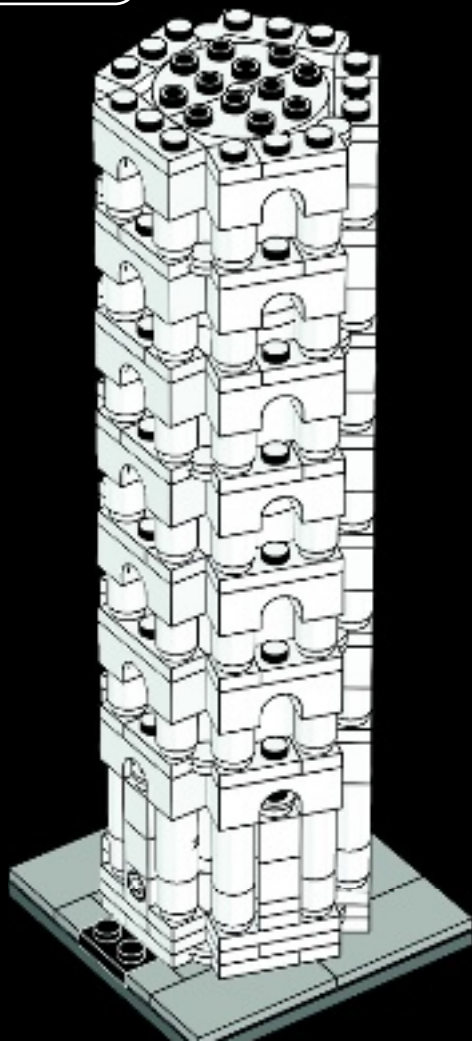


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2x

54





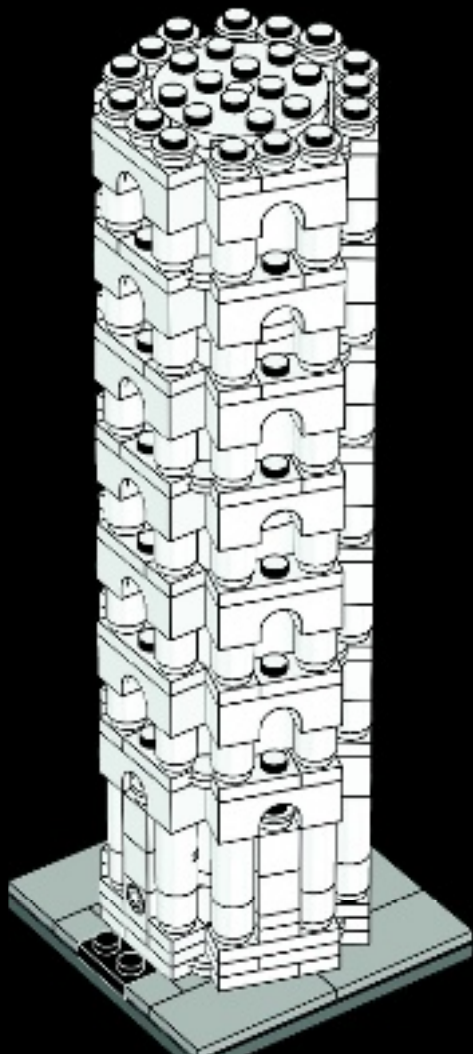


15x



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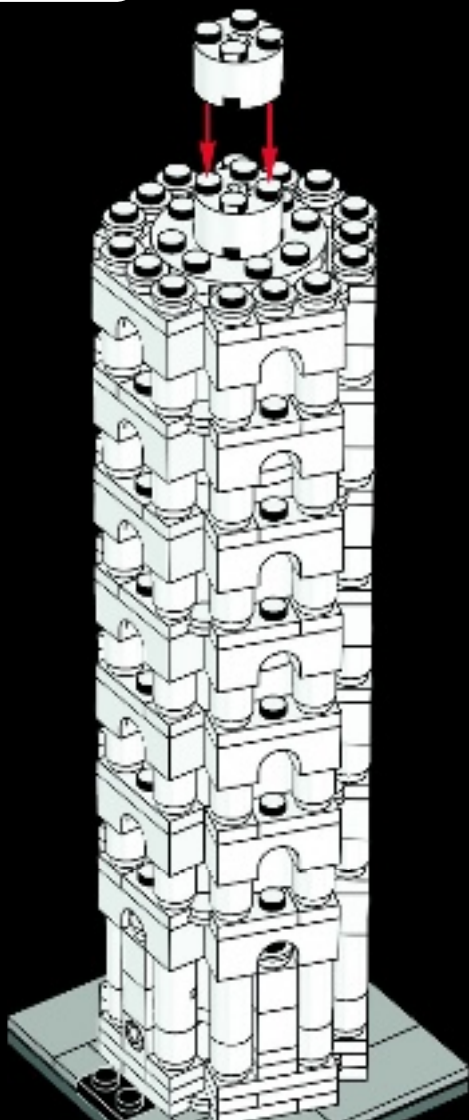
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2x

# 56



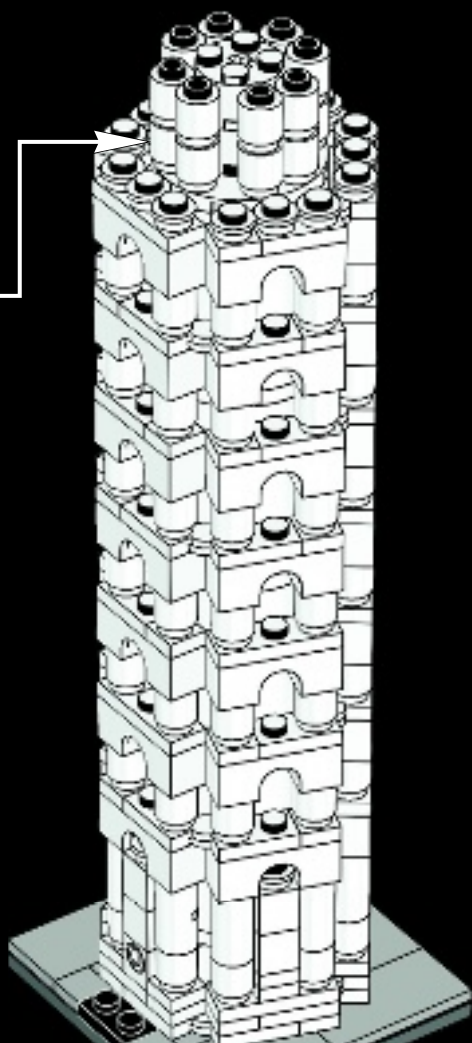


16x

57



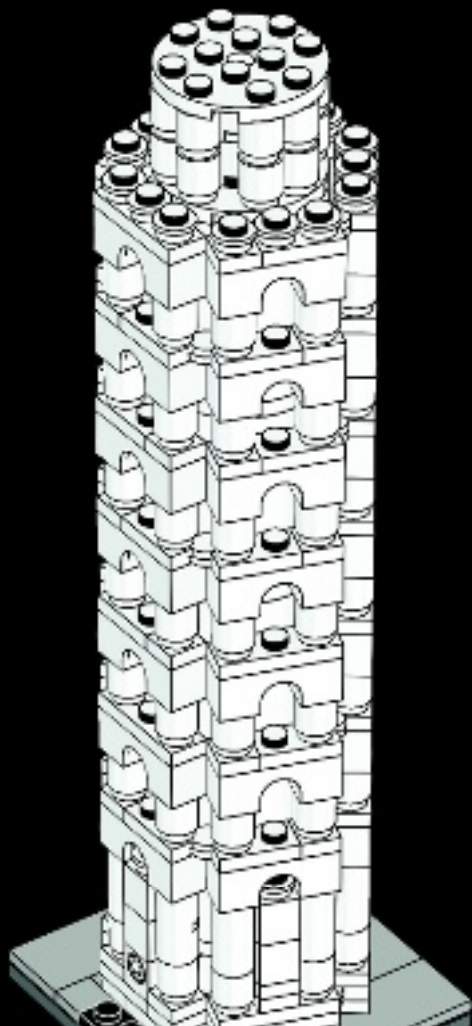
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# 58



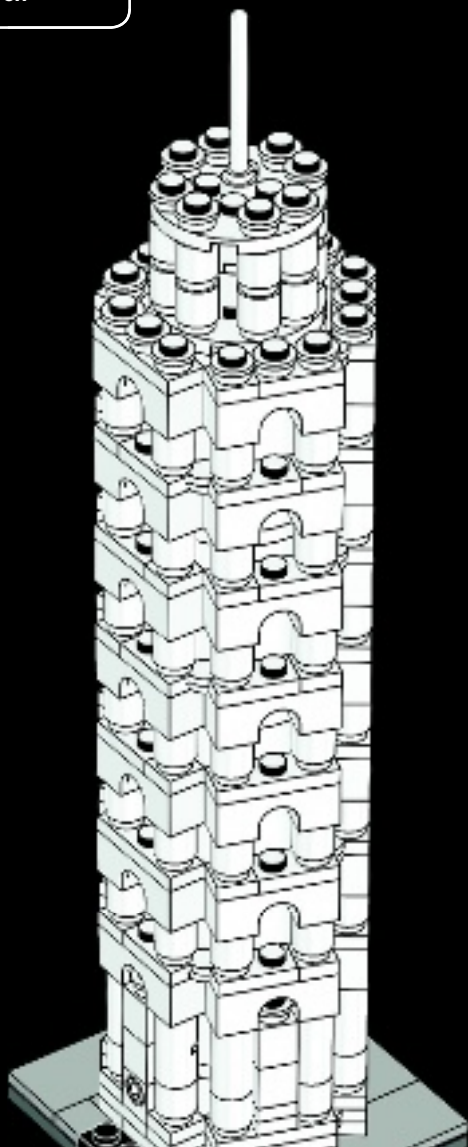


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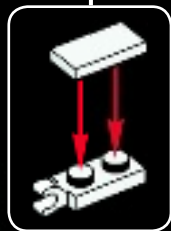
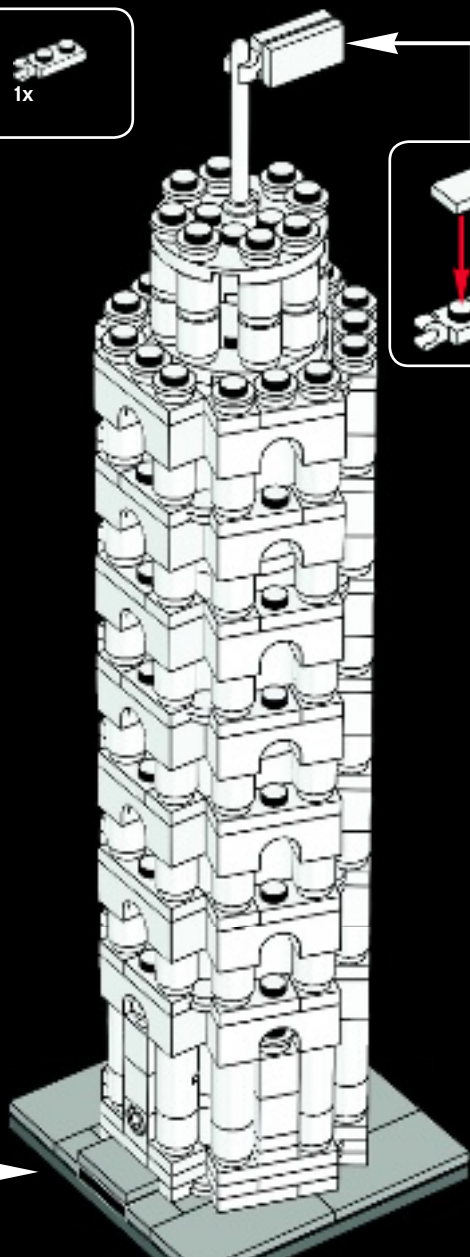
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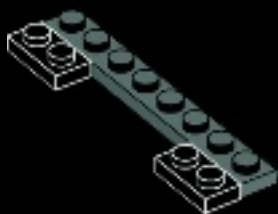
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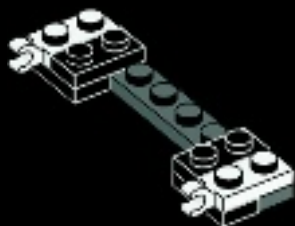
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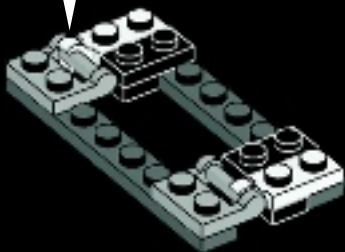
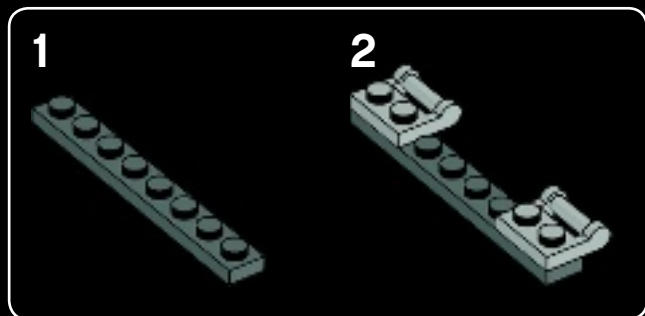


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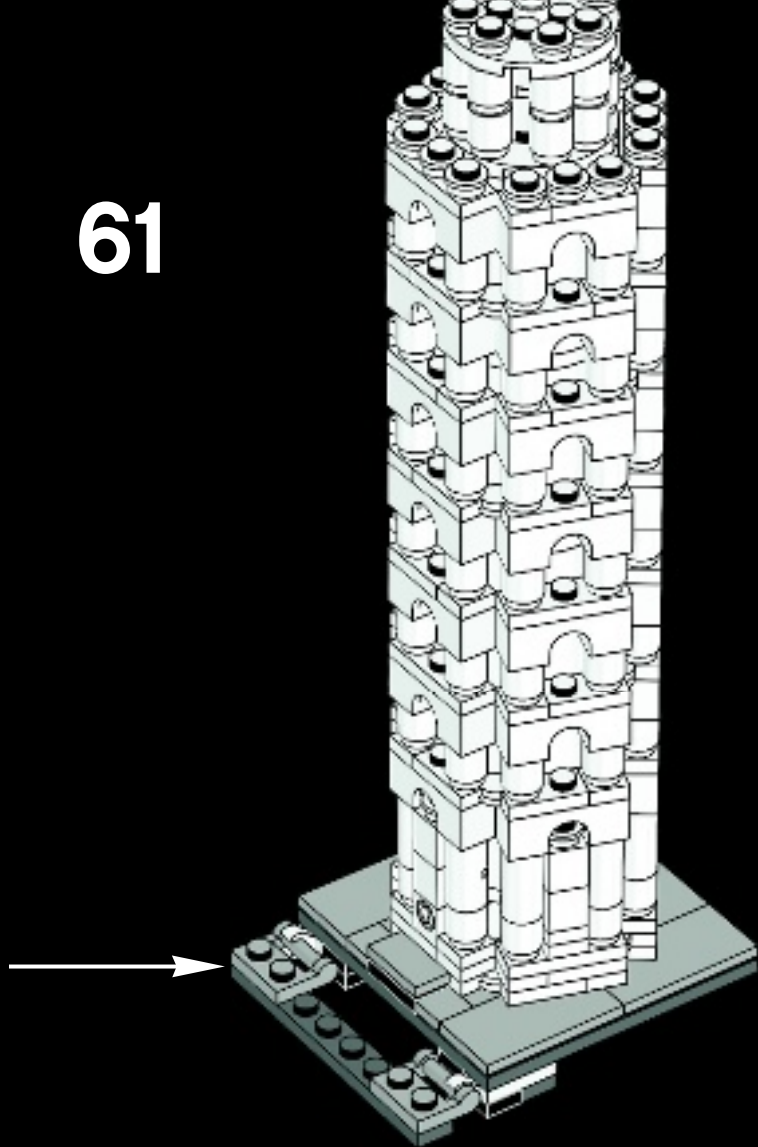


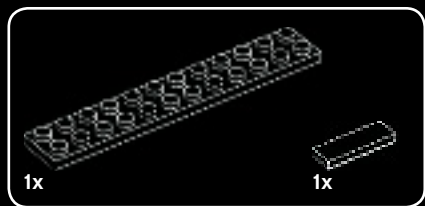
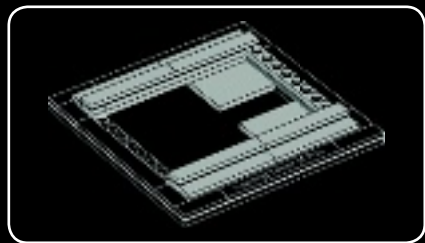
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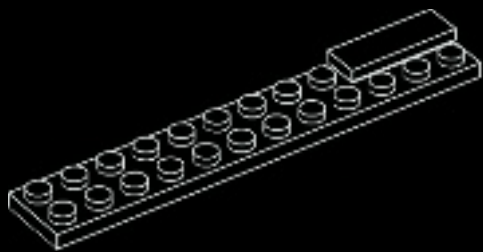


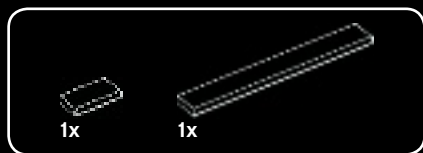
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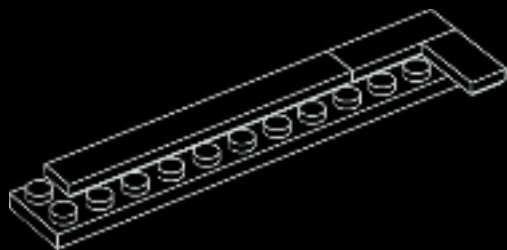


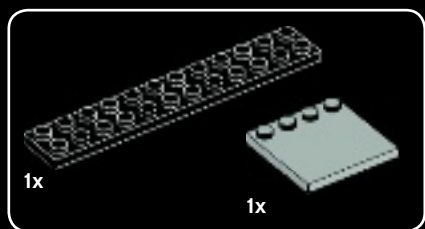
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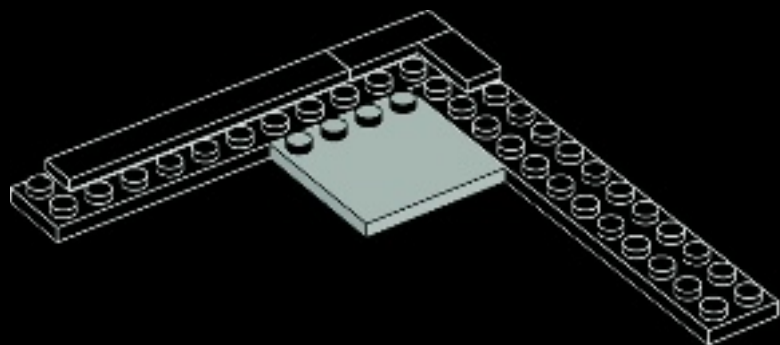


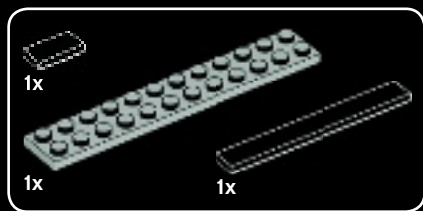
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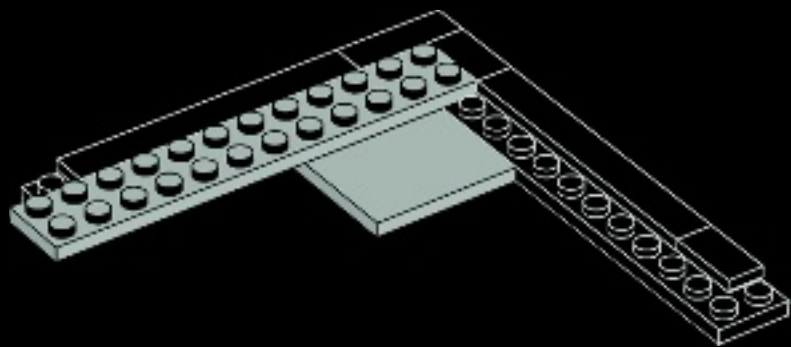


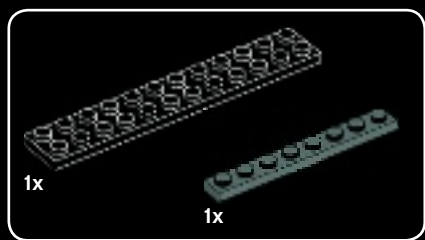
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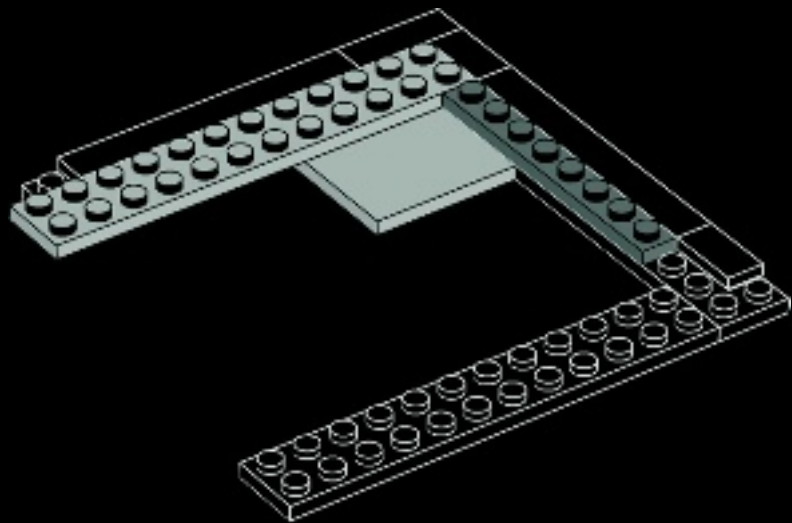


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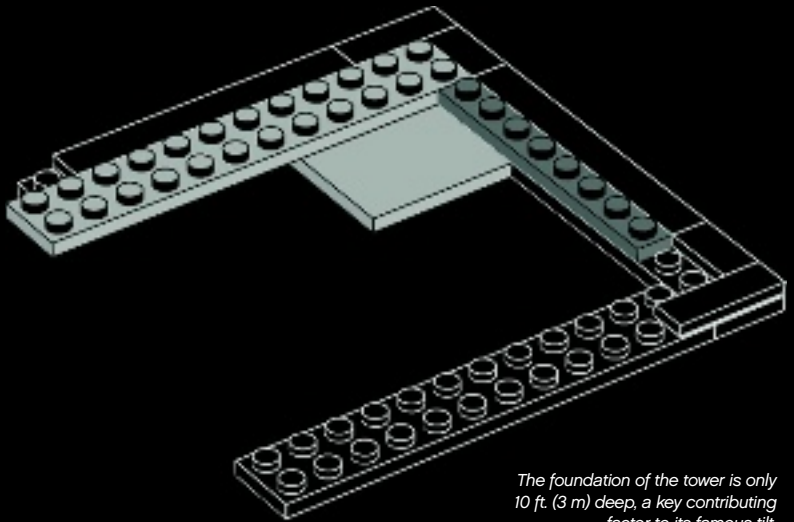
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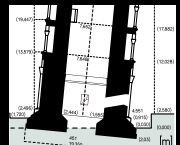
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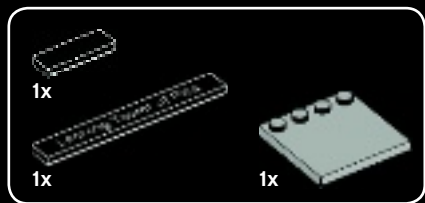


*The foundation of the tower is only 10 ft. (3 m) deep, a key contributing factor to its famous tilt.*

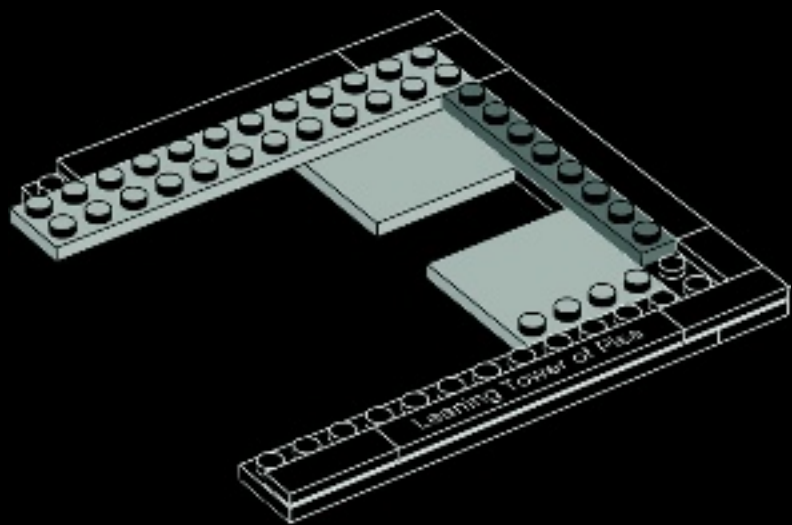
*Le fondazione della torre è profonda solo 3 m e questa è la causa principale della sua inclinazione.*



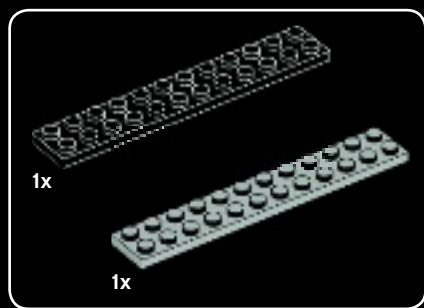
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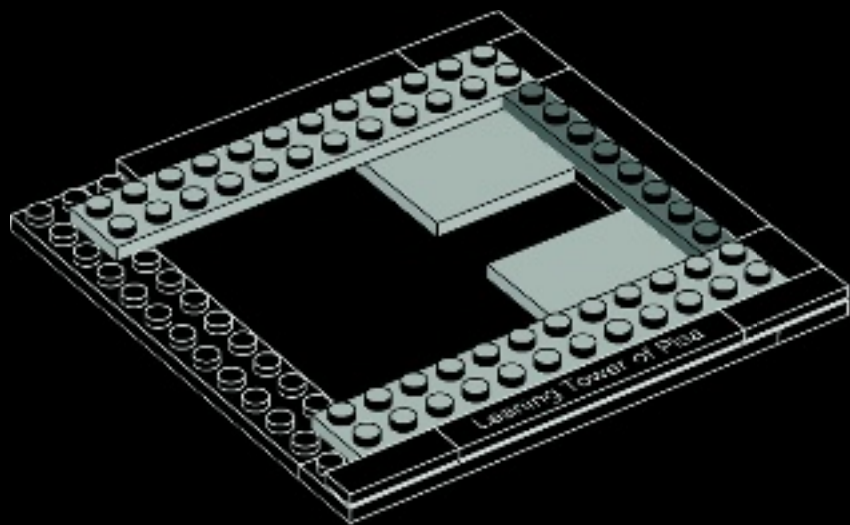
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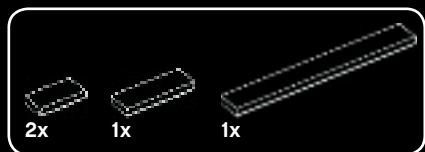




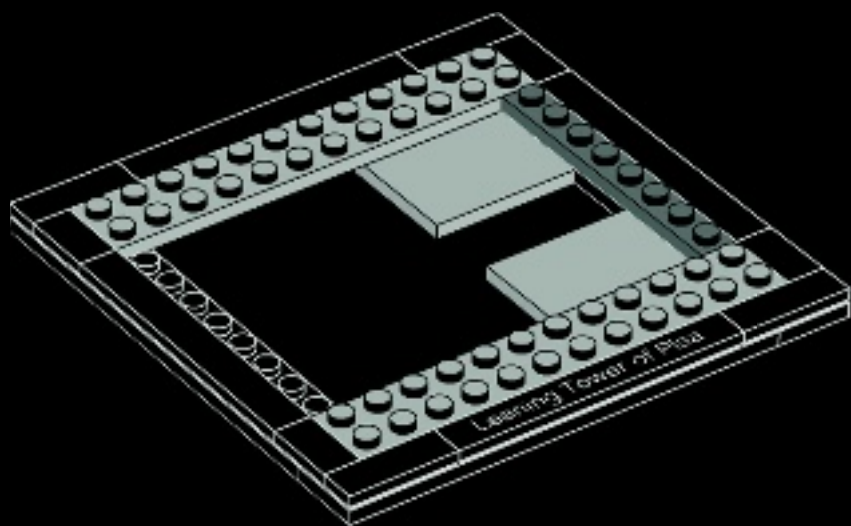


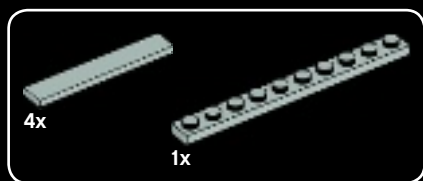
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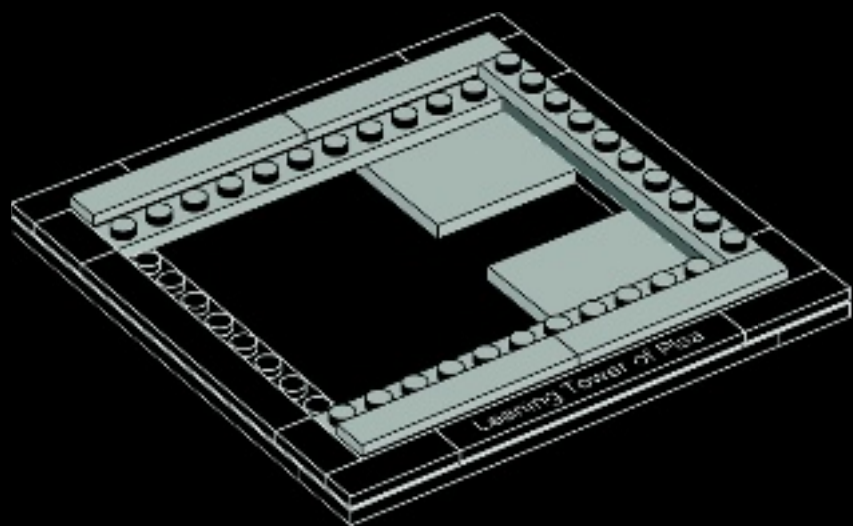


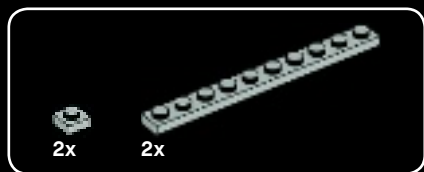
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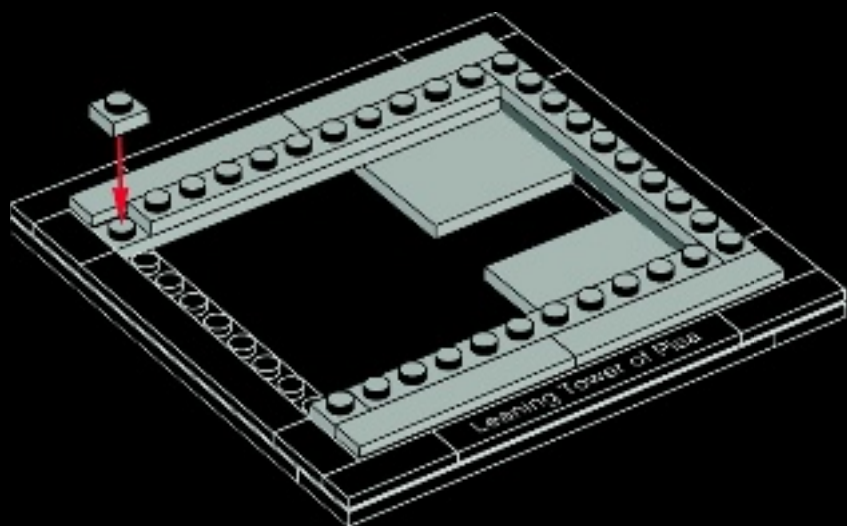


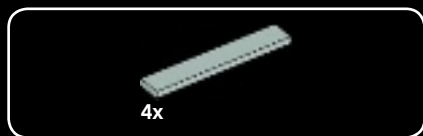
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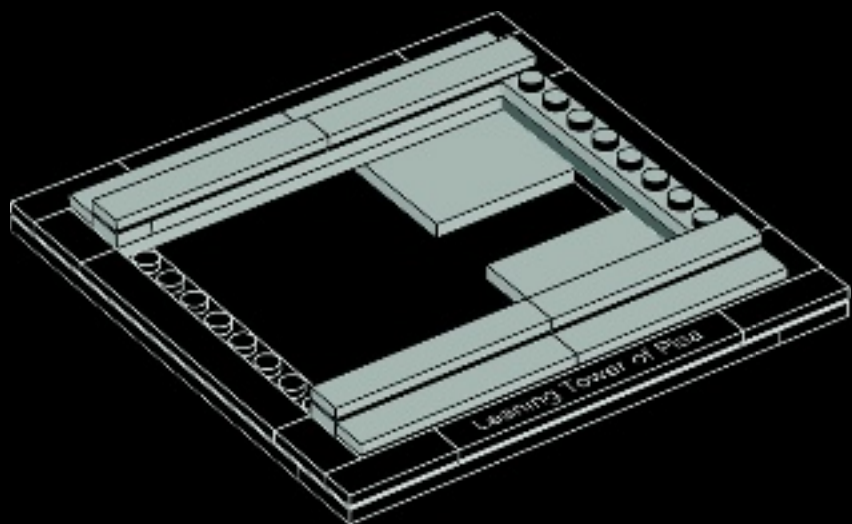


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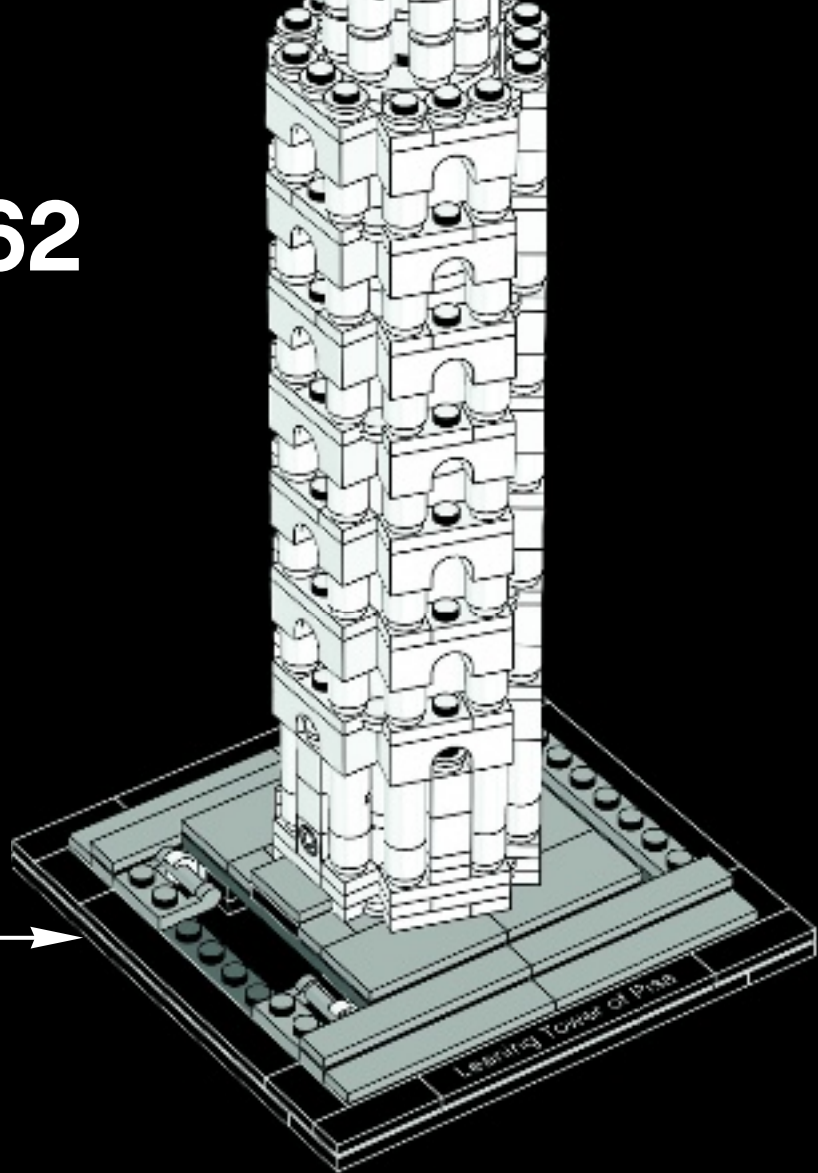




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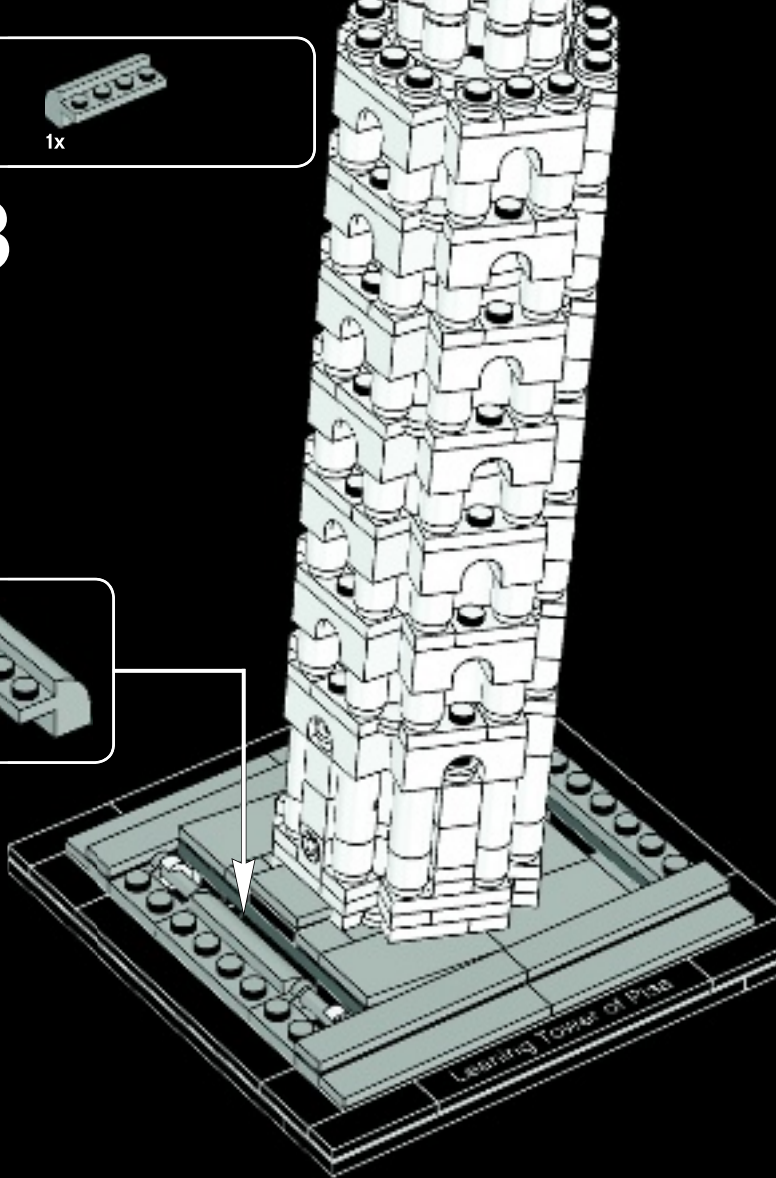
62





1x

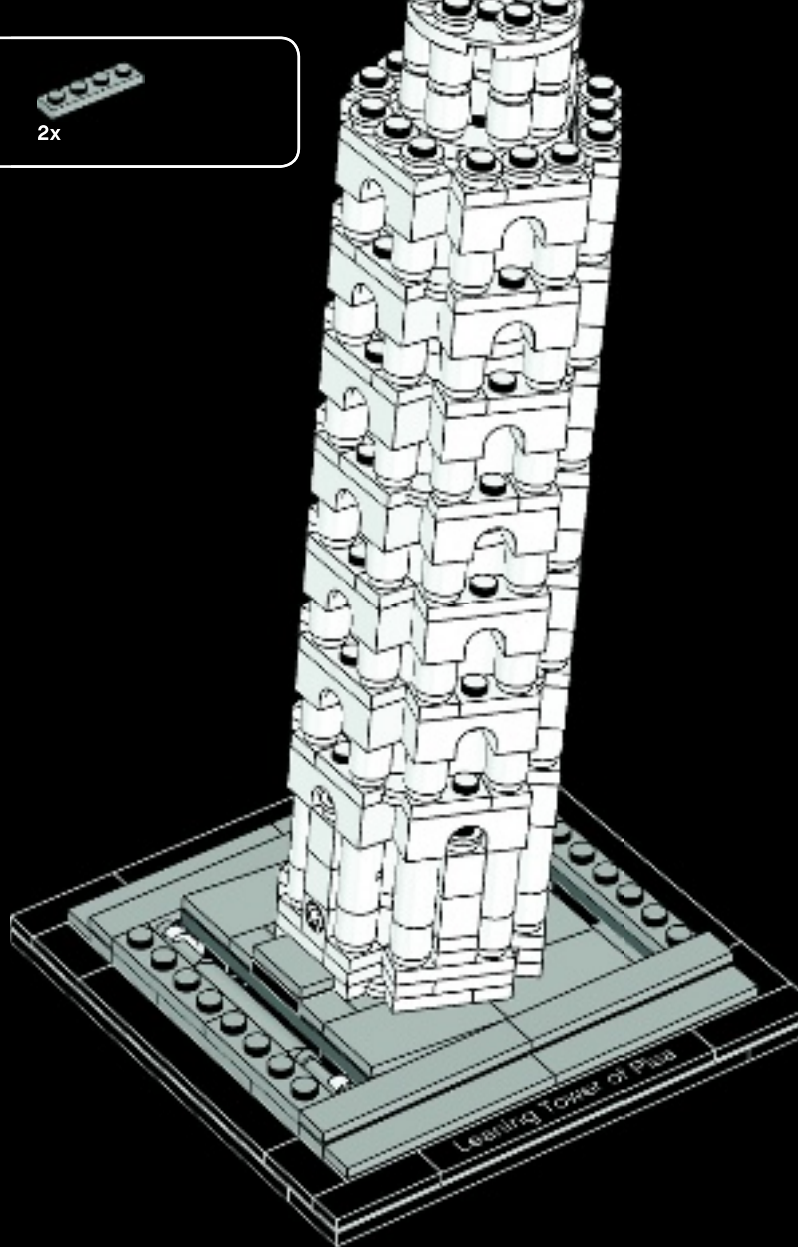
# 63





2x

# 64

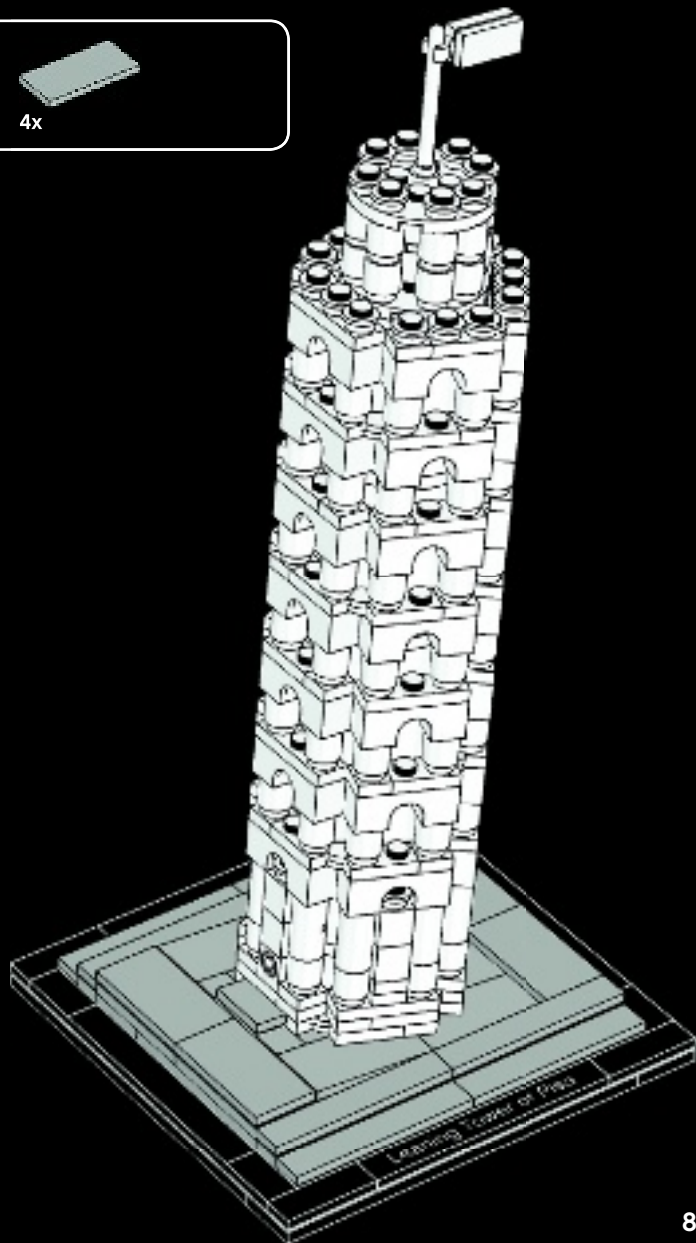






4x

# 65



# A Word from the Artist

“As an Architectural Artist, my desire is to capture the essence of a particular architectural landmark into its pure sculptural form. I first and foremost do not view my models as literal replicas, but rather my own artistic interpretations through the use of LEGO® bricks as a medium.

In an attempt to appeal to the vast admirers of the Leaning Tower of Pisa, our specific aim was to ensure that it could be both afforded and constructed by anyone looking to enjoy displaying a miniature Pisa they can call their own. To do so, I needed to adhere to a minimal element/part pallet, which would affect the model's scale, level of detail and construction techniques while maintaining structural integrity.

Exploring different, creative solutions and incorporating artistic license makes it possible to capture the essence of the structure without sacrificing its identity. Once the identifiable features, subtle details, and overall form were completed, I turned my attention to accomplishing the task of what color would best represent the building materials used in the real structure. The color selection turned out to be rather effortless since white was the clear choice for representing the tower's white Italian marble from Carrara.”

*Adam Reed Tucker*



The Leaning Tower of Pisa model was created in close collaboration with the LEGO design team. They look at the model from a LEGO building point of view and ensure the construction process is simple, logical, and a positive experience for the user.



# L'opinione dell'artista

Nelle vesti di artista specializzato in architettura, il mio desiderio principale è catturare l'essenza di un'opera architettonica nella sua pura forma scultorea. Innanzi tutto, non considero mai i miei modelli delle semplici e fedeli copie, ma interpretazioni artistiche, ottenute attraverso l'uso dei mattoncini LEGO®.

Nel tentativo di rendere il modello attraente ai tanti ammiratori della torre pendente, il nostro obiettivo specifico è stato assicurare che potesse essere acquistato e costruito da chiunque desiderasse realizzare ed esporre una torre di Pisa in miniatura. Per far ciò, mi sono attenuto a una palette di elementi/parti di base, la quale ha poi inciso sulla scala del modello, il livello dei dettagli e la tecnica di costruzione, pur mantenendo l'integrità strutturale.

Esplorare diverse soluzioni creative e incorporare licenze artistiche permette di catturare l'essenza della struttura senza sacrificarne l'identità. Dopo aver completato le caratteristiche identificabili, i dettagli più minuti e la forma complessiva, ho rivolto la mia attenzione alla rappresentazione cromatica dei materiali utilizzati nella struttura reale. La selezione del colore si è rivelata abbastanza facile, in quanto il bianco è stata una scelta ovvia per rappresentare il marmo di Carrara della torre.

Adam Reed Tucker



Il modello della torre di Pisa è stato realizzato in stretta collaborazione con il team di progettazione LEGO. Il team approccia il modello dal punto di vista della costruzione LEGO, assicurando che il processo sia semplice e logico e sia un'esperienza positiva per l'utente.

# The ‘Scale Model’ line – LEGO Architecture in the 1960s

The history of the current LEGO Architecture series can be traced back to the beginning of the 1960s, when the popularity of the LEGO brick was steadily increasing. Godtfred Kirk Christiansen, the then owner of the company, began looking for ways to further expand the LEGO system and asked his designers to come up with a set of components that would add a new dimension to LEGO building.

Their answer was as simple as it was revolutionary: five elements that matched the existing bricks, but were only one third the height. These new building “plates” made it possible to construct more detailed models than before.

This greater LEGO flexibility seemed to match the spirit of the age; modernist architects were redefining how houses looked, and people were taking an active role in the design of their dream homes. It was from these trends that the LEGO ‘Scale Model’ line was born in early 1962.

The name itself was a direct link to the way architects and engineers worked, and it was hoped that they and others would build their projects ‘to scale’ in LEGO elements. As with LEGO Architecture today, the original sets were designed to be different from the normal, brightly colored LEGO boxes, and also included ‘An Architectural Book’ for inspiration.

Though the five elements remain an integral part of the LEGO building system today, the ‘Scale Model’ line was phased out in 1965. Many of the principles from the series would re-emerge over 40 years later in the LEGO Architecture series we know today.



# La linea ‘Scale Model’

## – LEGO Architecture negli anni ‘60

La storia della corrente serie di LEGO Architecture può essere fatta risalire agli inizi del 1960, quando la popolarità del mattoncino LEGO era in costante aumento. Godtfred Kirk Christiansen, l'allora proprietario della società, stava ricercando nuovi metodi per ampliare ulteriormente il sistema LEGO e chiese ai suoi designer di ideare una serie di componenti che aggiungessero una dimensione originale alle costruzioni LEGO.

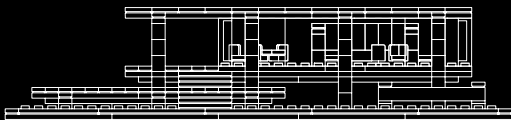
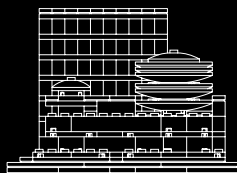
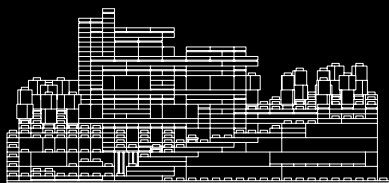
La loro risposta fu tanto semplice quanto rivoluzionaria: cinque elementi che riprendevano il concetto dei mattoncini esistenti, ma alti solo un terzo. Queste nuove piattaforme di costruzione consentirono di realizzare modelli più dettagliati.

Questa maggiore flessibilità in LEGO era senza dubbio al passo con i tempi: gli architetti modernisti stavano infatti ridefinendo il concetto di edificio e le persone cominciarono a interessarsi attivamente al design della loro “casa dei sogni”. Fu proprio da queste tendenze che, nei primi mesi del 1962, nacque la linea LEGO ‘Scale Model’.

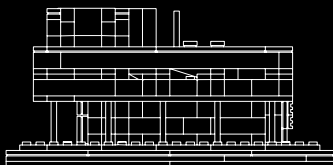
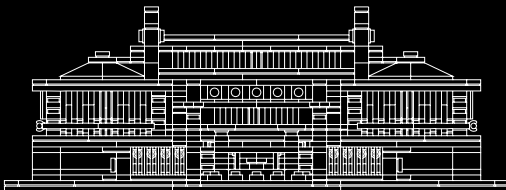
Il nome in sé era un collegamento diretto con il modo in cui architetti e ingegneri lavoravano e si sperava che anche altri avrebbero seguito il loro esempio, realizzando modelli in scala con gli elementi LEGO. Così come con LEGO Architecture oggi, i set originali furono progettati per essere diversi dalle solite coloratissime confezioni LEGO e comprendevano anche ‘Un Libro di architettura’, con idee ispiratrici.

Sebbene i cinque elementi siano ancora una parte integrante del sistema di costruzione LEGO, la linea ‘Scale Model’ fu messa fuori produzione nel 1965. Molti dei suoi principi sarebbero stati ripresi 40 anni più tardi, nella serie LEGO Architecture che conosciamo oggi.

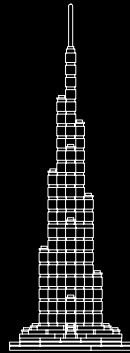
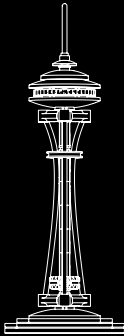
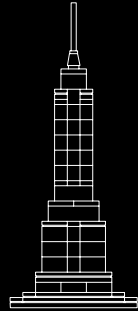
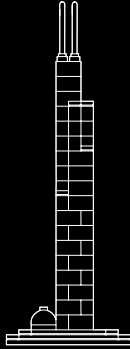
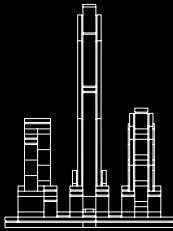
# Architect series



# Serie Architect

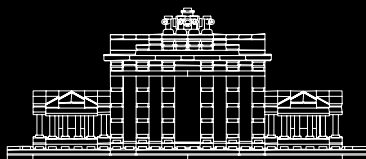
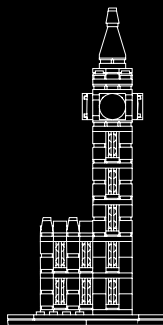
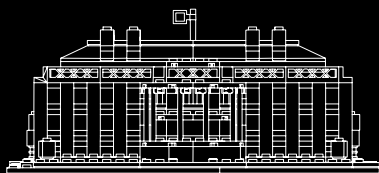


# Landmark series





# Serie Landmark



# References

## Text credits:

[www.leaningtowerofpisa.net](http://www.leaningtowerofpisa.net)

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[en.wikipedia.org](http://en.wikipedia.org)

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# Ringraziamenti

## Testo:

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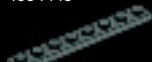
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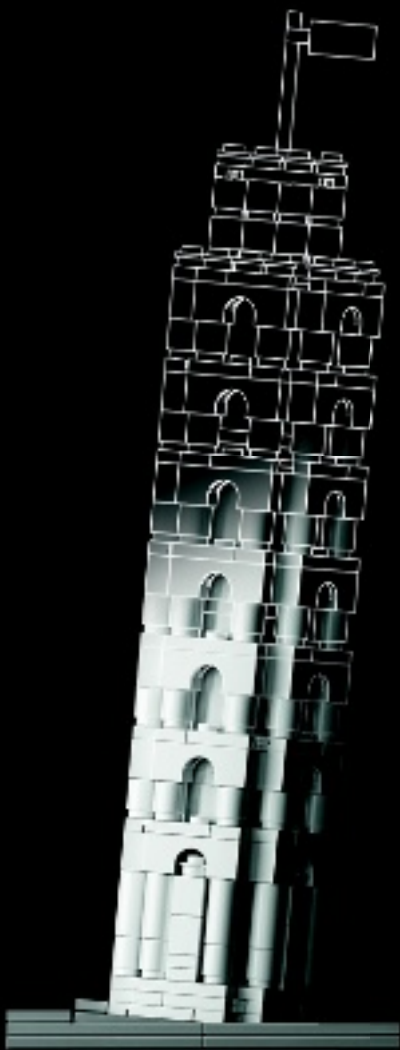
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Architecture



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