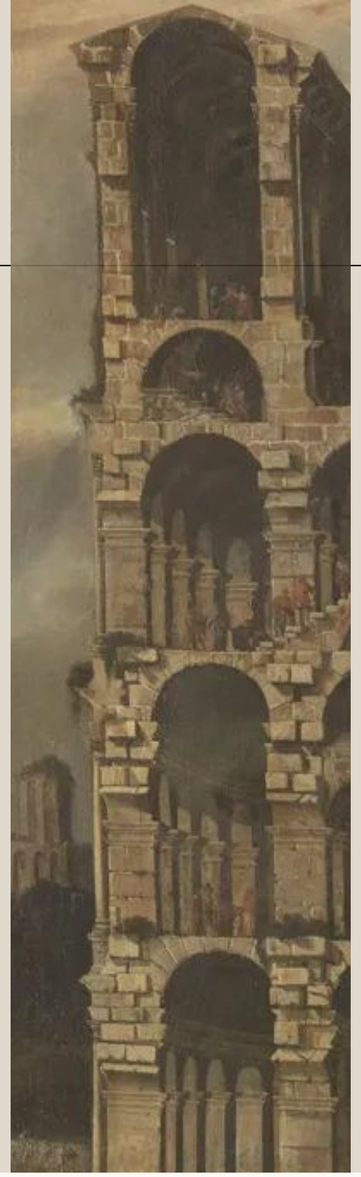
DESIGN DISASTERS

Disaster at Fidenae Amphitheatre

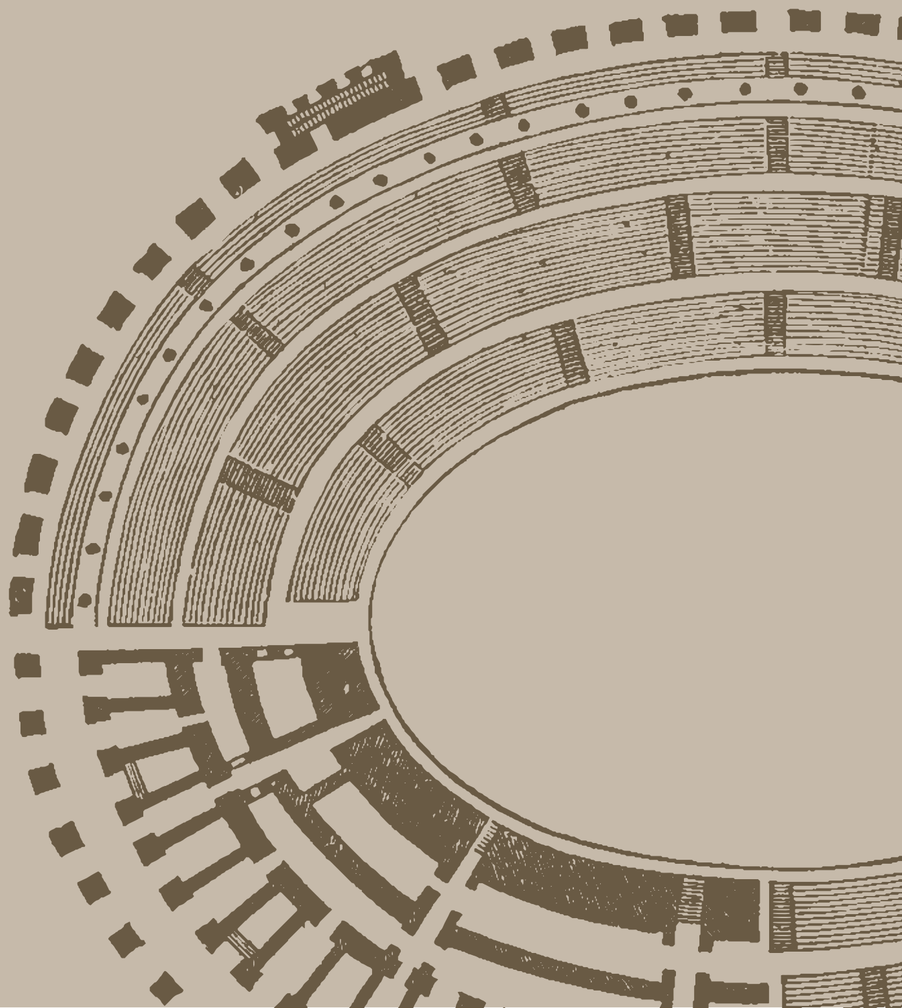
Aarya, Fynn, Lara, & Lizzie



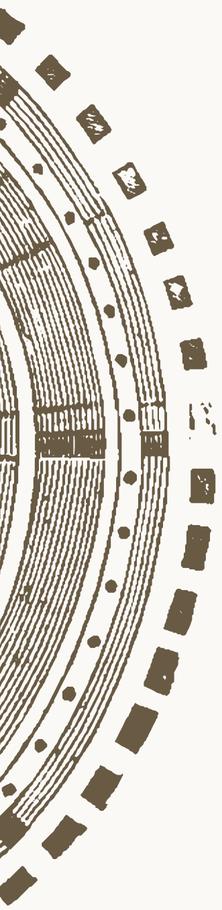
Fidenae Amphitheatre

What Happened?

The Fidenae Amphitheatre collapse in 27 AD holds the Guinness world record for history's "worst sporting disaster". Looking back on this design disaster from nearly 2,000 years ago showcases how design errors are by no means new. Since ancient times, designers have made mistakes with tragic consequences arising from a variety of culminating factors. According to historians of the time, 20,000 people were left dead by the time the dust settled. Therefore, it is vital for us, as designers, to look back upon the faults of the past in order to learn and prevent analogous tragedies from occurring.



Fidenae Amphitheatre



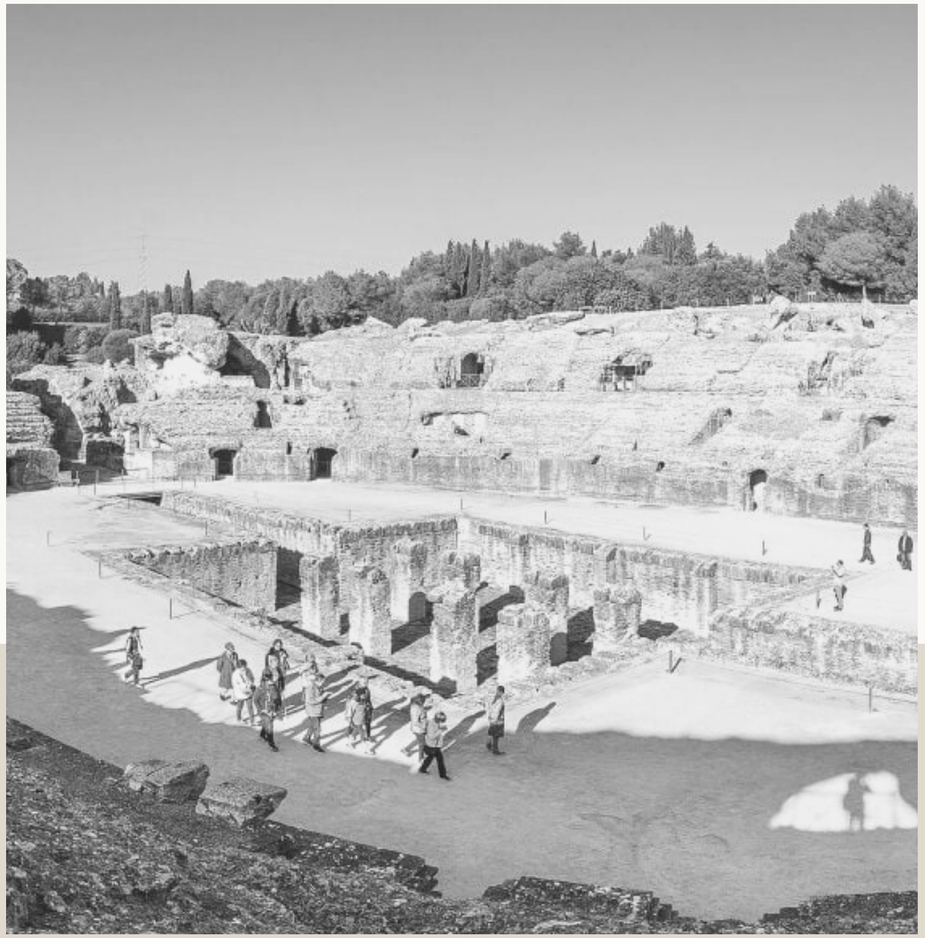
Why it Happened?

It is vital to explore these faults made through varying design principles to examine just how and why they occur and ways to prevent these disasters from reoccurring in the future. Throughout the report, we will consider design principles that influenced the event. A main fault of the amphitheatre could be accredited to its poor foundations and a badly jointed timber framing. Another could account that the architect just worked for the reward, without having any experience. In addition, the amphitheatre was designed with consideration for aesthetics but not much attention was paid to other pertinent structural features for its success. This included the use of poor materials such as wood which does not hold much integrity. We will look at all the design principles to ascertain how the construction of the amphitheatre did or did not follow the principles and the ways in which we can use design principles to examine how to prevent it from occurring again.

Fidenae Amphitheatre

How was it Preventable?

Evidently, there was no main factor that led to the collapse of the Fidenae amphitheatre. To highlight the main ways to prevent a tragedy such as this from occurring again it is pivotal to outline the main areas of fault and categorise these areas to identify each level of error, from the production process to external influences and even psychological factors.



Throughout this report, these three main categories are highlighted with relevant design principles to not only display the areas of fault but also ensure how it can be prevented from occuring again.

The Design Principles

Failure from a design point of view

01 ERRORS

02 STRUCTURAL FORMS

03 GOLDEN RATIO

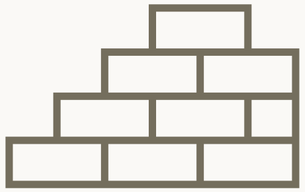
04 FACTOR OF SAFETY

05 SCALLING FALLACY

06 CONTROL

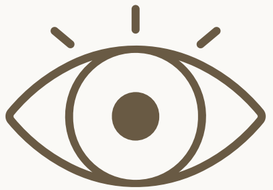
07 EXPECTATION EFFECT

08 EXPOSURE EFFECT



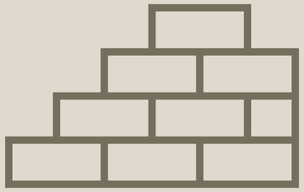




Structural Flaws

01
ERRORS

02
STRUCTURAL FORMS

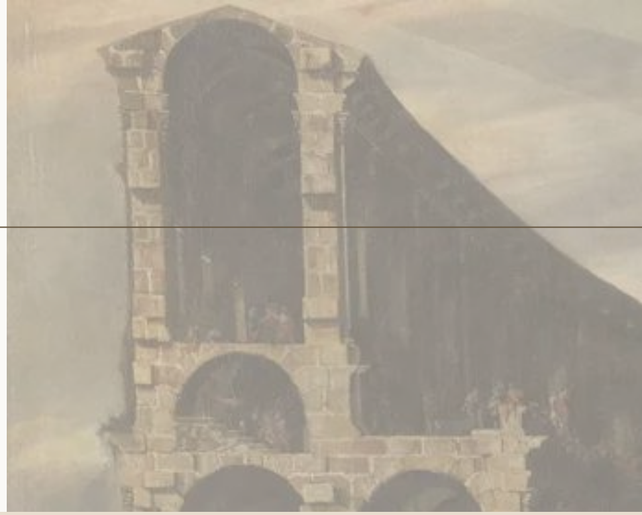


03
GOLDEN RATIO

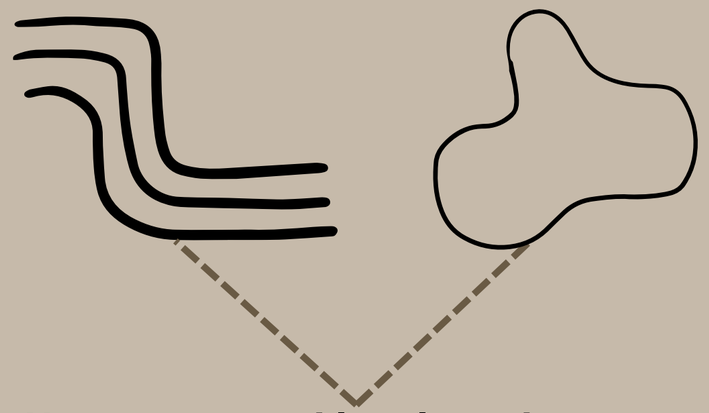
When investigating the causes of a design disaster, it is helpful to categorise the design principles that influenced the event. On a structural level, the Findenae Amphitheatre was incredibly flawed.

ERRORS

An action or omission of action yielding an unintended result (Lidwell, 2010).



When observing the error of the construction of the Fidenae amphitheater, the error can be diagnosed through the three different types of mistakes: perception, decision, and knowledge. As Atilius was more concerned with the psychological reward of building the amphitheater, he was not concerned with following the principles to avoid an error. Tacitus claims that the amphitheatre was not "*on ground of tested solidity*" (Tac. Ann. 4.63), alluding to the idea that if Atilius had considered the different types of soil he was building on, it would have revoked the chance of error.



Uneven ground levels and uneven levels of space are said to be one of the main errors made and demonstrates lack of consideration prior to construction.

This would have followed the solutions guided under decision and knowledge which would have led to the avoidance of the fatalities that occurred due to the collapse. Additionally, during the construction of the amphitheatre, there should have been room given for forgiveness in the event that an error could have arisen, it would be have been addressed, yet due to the lack of thought given to the principles of structural forms, no room for forgiveness was created and ultimately resulted in complete error. This reiterates the fault by design in error, as the lack of consideration inevitably yielded an unintended result.

STRUCTURAL FORMS

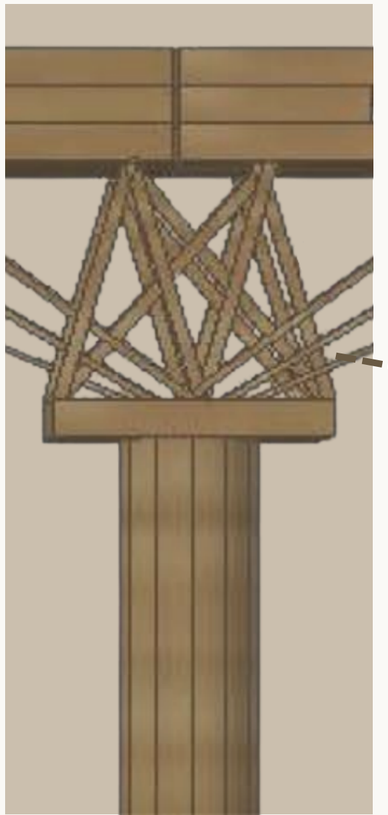
There are three ways to organise materials to support a load or to contain and protect something: mass structures, frame structures, and shell structures (Lidwell, 2010).

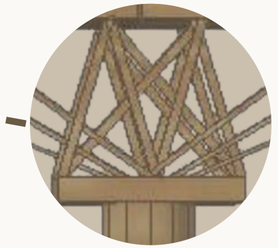
In-depth observations of the mass and frame structure magnify the understanding of the event and the fatalities that occurred and therefore tie into the principles of error that were the ultimate outcome of this construction. There are three main basic structures of structural forms; mass, frame, and shell structures. Out of the three basic structures, both mass and frame co-exist in the structure of the Fidenae Amphitheatre and magnify the errors that ultimately led to its collapse.

The design of the amphitheatre was compromised on two of the sections of the wooden framing as they were not joined well ."This type of collapse means the design was comprised of two main sections of the wooden framing and if these sections were not joined well, this could have led to the upper half of the frame splitting from the lower in a manner in which one of the sections could have fallen inwards towards the arena and the other half could have fallen outwards crushing those around the perimeter" (Napolitano & Monce, 2018). Strong joints were not used in the construction of the amphitheatre.

The combination of both a lack of physical foundation but also mental structure to complete this project exemplifies why and how the principles of structure forms were not used and how that manifests into error, an omission where an unintended result is achieved yet this should have been apart due to the unorganised planning of the amphitheatre.

Evidence of the poor framing as shown in archaeological evidence.



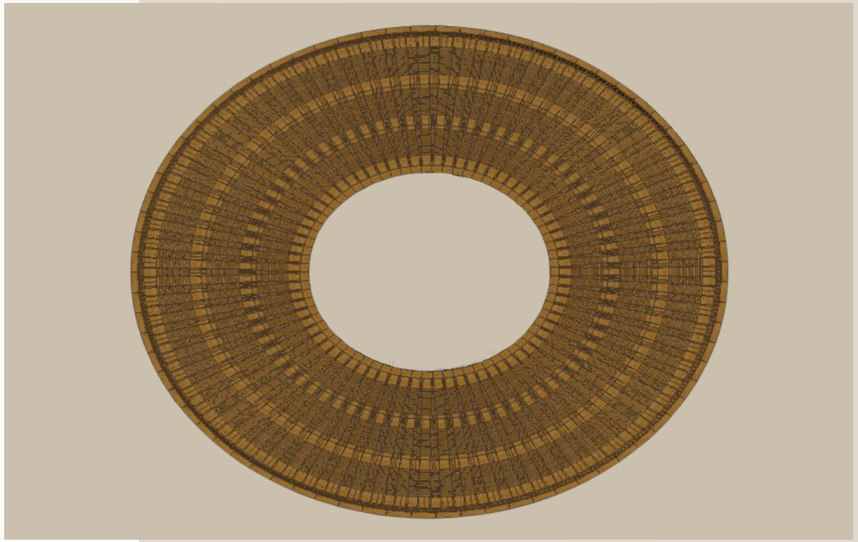


Evidence of poor structural forms and the wooden framing poorly joined together.

GOLDEN RATIO

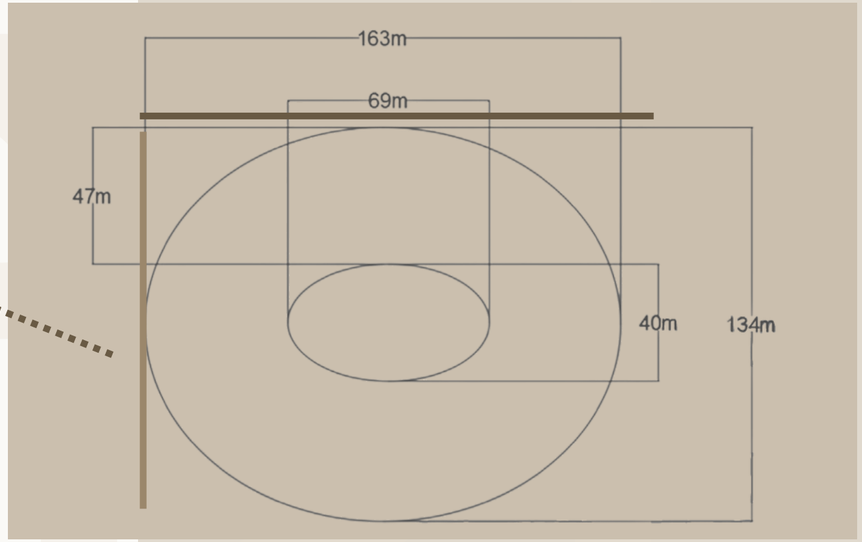
A ratio within the elements of form, such as heigh to width, approximating 0.618 (Lidwell, 2010).

The golden ratio is found throughout numerous features in everyday life including nature, art, and even architecture. The use of the golden ratio although unknown by knowledge in its application could be parted to the subconscious choice for aesthetics, resulting in the ratio. The ratio is a great feature, especially when considering ancient architecture, though should only be considered when it is not at the expense of other design objectves (Lidwell, 2010).



When considering the ratio with the Fidenae ampitheatre, it is evident a level of aesthetics was considered during the production. Evidently so, the ampitheatre seemed to be designed with consideration for aesthetics, though the consideration of weight was completely dismissed, which was one of the main structural flaws in its design (Napolitano & Monce, 2018). Although the golden ratio applies within the context of aesthetics, the disregard for other design objectives such as its structural integrity led to its collapse.

The spherical nature of the ampitheatre allowed for areas double in length than width, matching the ratio.



Elements of Fault

04

FACTOR OF SAFETY

05

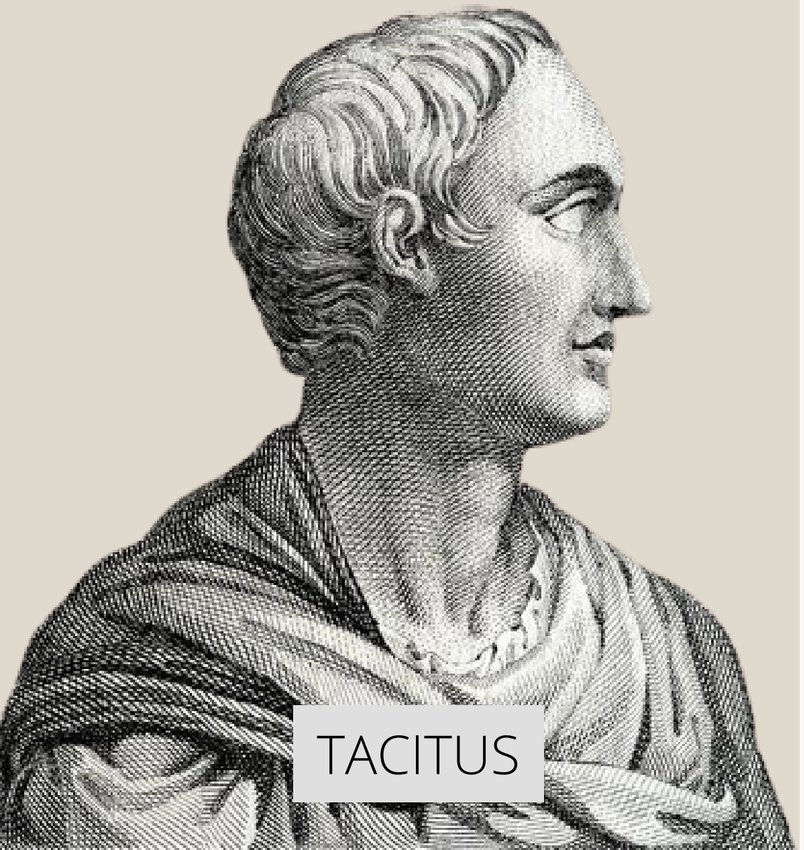
SCALLING FALLACY

06

CONTROL

Whenever a design fails, it is essential to consider the granular reasons for the disaster. Therefore, there are always attempts to attribute causation to external factors. Such elements can be better understood through the lens of design principles.

“He neither placed the foundations under the structure through to the solid ground nor did he build the wooden framework with strong joints” (Tac. Ann. 4.62)


TACITUS

FACTOR OF SAFETY

The use of more elements than thought to be necessary to offset the effects of the unknown variables to prevent system failure (Lidwell, 2010)

There is a long list of grave unnatural accidents caused by engineering or the lack thereof and the Fidenae amphitheatre collapse is one of them. The stadium was built hastily to meet the deadline. This shows that the amphitheatre was not built considering all the factors and by not taking the necessary safety measures. When observing the mass and frame structure of the amphitheatre, a vital source that stretches the issues that undermine the collapse is a detailed account by Tacitus: “He neither placed the foundations under the structure through to the solid ground nor did he build the wooden framework with strong joints” (Tac. Ann. 4.62). Furthermore, linking the design principle of error, Tacitus stated that Atilius did not work with an abundance of money nor did he strive to make a name for himself but “rather he undertook that work for sordid reward.” (Tac. Ann. 4.62). Fidenae was considered just like another amphitheatre built in Rome and was built considering the same factors as any other amphitheatre.

SCALLING FALLACY

A tendency to assume that a system that works at one scale will also work at a larger scale (Lidwell, 2010).

Rome is said to be famous for its history and culture, and also its architecture. Fidenae was built taking all the other famous amphitheaters as an example, but it didn't work out successfully as it was not built under similar circumstances. There were many variations as the cheap material of low quality was used and it was also built in a rush so a lot of important things weren't considered. The seating capacity was not taken into account.

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Even though the aesthetics were considered during the construction of the amphitheatre, a lot of important variables such as the uneven ground and the weight were not considered. Designing something which looks good isn't enough, there should be a balance between it being aesthetic and having a strong foundation. The location also wasn't suitable for the amphitheater.This principle tells us that the scaling fallacy is when people falsely assume that something that works at one size will also work at another size.

CONTROL

The level on control provided by a system should be related to the proficiency and experience levels of the people using the system (Lidwell, 2010).

Atilius
THE FREED SLAVE

"An ex-slave called Atilius started building an ampitheatre at Fidenae... but he neither rested his foundations on solid ground nor fastened the wooden superstructure securely" (Grant, 1967).

Individuals should be able to exercise control over a system, but that level of control must align with their proficiency with the system (Lidwell, 2010). This is great to consider with the Fidenae amphitheatre, as many claims of its failure fall back on the creator. Atilius was the figurehead behind the construction of the ampitheatre and was said to be highly ambitious although, was ignorant of certain construction techniques and characteristics of the site. This included improper fastening of the seating to the structure and unsuitable land for a building of such grand structure (Dyrud, 2013). Due to his negligence and the deaths of thousands, ancient sources state he was "banished" for his part in the disaster. Evidently so, control in a system should reflect back on the levels of experience and require deep consideration, as Atilius was regarded as someone who only sought wealth which ultimately led to the demise of the Amphitheatre.

User's Psychology

07

EXPECTATION EFFECT

08

EXPOSURE EFFECT

The scale of the catastrophe was enabled due to the large turnout of tens of thousands of spectators on the day of the theatre's opening (The Historian's Hut, 2018). It is valuable to consider design principles that explain what influenced so many people to flock to the amphitheatre on opening day, in spite of its rushed construction and poor workmanship.

EXPECTATION EFFECT

A phenomenon in which perception and behaviour changes as a result of personal expectations or the expectations of others (Iidwell, 2010).

Roman citizens at the time were likely to have noticed the poor workmanship of the construction or at least the short time in which the amphitheatre was constructed. Despite these reasons for valid scepticism, the general expectation for buildings is to be designed to be sturdy and be able to hold a large number of people. Even today, when new buildings, including grand stadiums, are open to the public, visitors mostly assume the best-case scenario and don't question its stability. This phenomenon is referred to as the "expectation effect" whereby "perception and behaviour changes as a result of personal expectations or the expectations of others" (Lidwell, 2010).

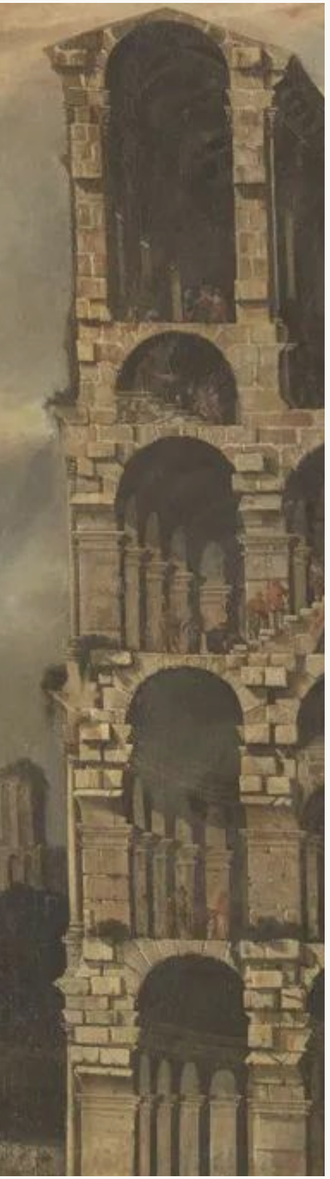
This design principle helps us to understand the factors behind the immense scale of the disaster and the high number of casualties. When the amphitheatre opened, masses automatically expected entertainment and a safe building in which to experience it. Therefore, it was difficult for people at the time to foresee the outcome of an event that was, as far as historians know, unprecedented. As the audience did not have any reason to expect there to be any room for error, tens of thousands unquestioningly entered, only to be tragically killed.

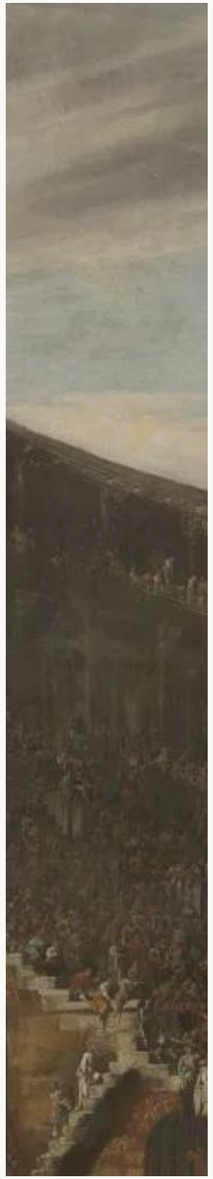
EXPOSURE EFFECT

Repeated exposure to stimuli for which people have neutral feelings will increase the likability of the stimuli (Lidwell, 2010).

The “exposure effect” is another design principle that helps explain why so many casualties were in the amphitheatre. This principle states that the “repeated exposure to stimuli for which people have mutual feelings will increase the likeability of the stimuli” (Lidwell 2010). This principle is often associated with advertising and marketing campaigns and is said to “enhance the perceived credibility … of designs” (Lidwell, 2010). This theory can be applied to this design disaster as the Fidenae Amphitheatre's grand opening was heavily advertised (thehistorianshut, 2018). Whilst we may associate advertising with modern print and digital technologies, outdoor advertising was also prevalent in the ancient world.

Advertisements were painted and carved onto surfaces that experienced high exposure such as on “the sides of buildings or large rocks near paths with heavy foot traffic” (LaFleur, 2016). In regions of ancient Rome where literacy was generally limited, advertisements would leverage the universal understanding of visual symbols. This practice is continued today and is referred to as the design principle of “iconic representation”, “the use of pictorial images to improve the recognition and recall of signs and controls” (Lidwell et al., 2003/2010a, pp. 132). Therefore, high exposure of advertising for the amphitheatre, likely using iconic representation, can be attributed as a cause to the mass numbers of audience members overcrowding the stadium which led to its collapse.





CONCLUSION

From everything we can gather, the Fidenae Amphitheatre wasn't an ideal piece of architecture. It had many flaws which inevitably resulted in its failure. If only more detail was paid to the design aspect of the building, the amphitheatre wouldn't have collapsed and all the countless lives taken would have never occurred. This teaches us that anything that's made without proper consideration of the main factors discussed, will not be efficient. The report investigates all the causes of the disaster in depth by visualising the amphitheater through the lens of design principles. We could conclude that on a structural level, with the inclusion of external factors and user psychology, the Fidenae Amphitheatre was incredibly flawed.

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