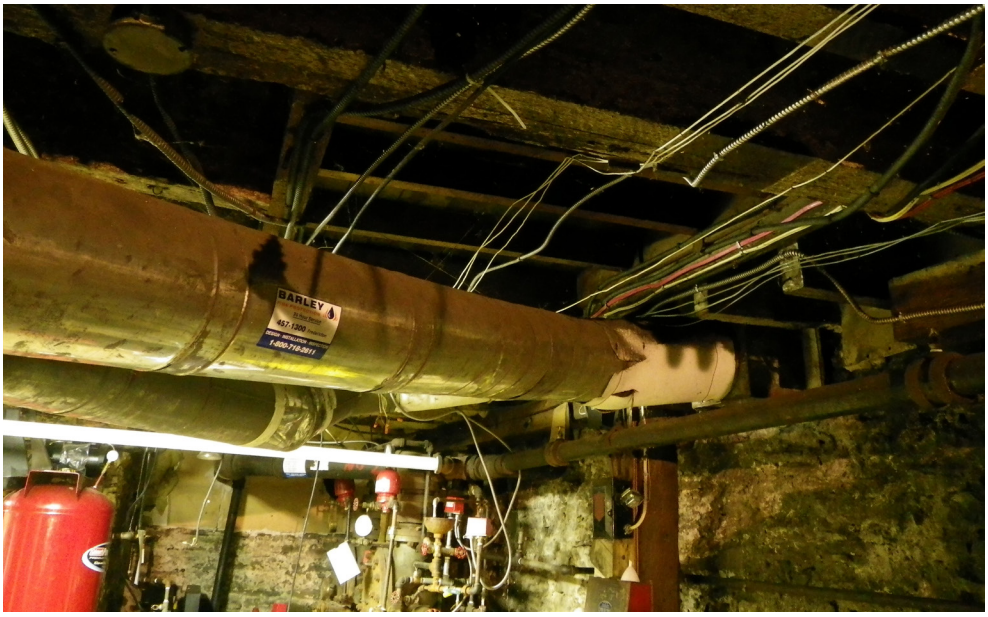

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Short discussions on conservation engineering

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What does the engineer do?

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When dealing with existing and historic buildings, or when taking on the conservation of a building, what is the role of the engineer? What can she or he provide to the project that is valuable and unique to their skill set?

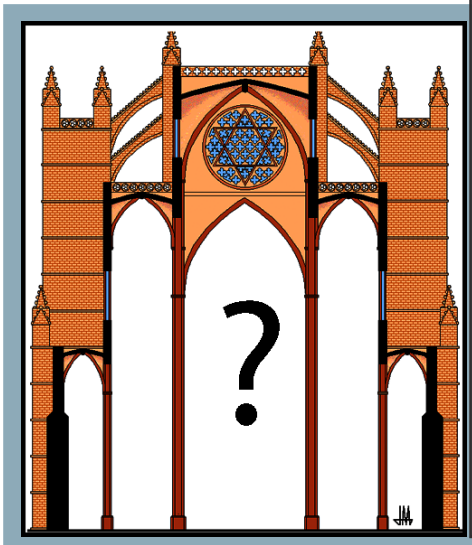
Engineering is a detail focused profession which strives to apply known science to find practical solutions to real problems. In structural engineering we have developed ways to understand a structure, be it buildings, bridges, or just a staircase.

Understand what? The structure is subject to forces, such as the weight of occupants, the weight of snow, the forces of wind, or the movements of the ground below. These many factors each create a type of load, stress and strain on the structure. Each structure behaves differently in response to these loads. A structure's behaviour is determined by the materials with which the building is constructed, its method and quality of construction, and its existing state.

It is an engineer's job to know the properties of the materials and their interactions when assembled. It is an engineer's job to know how the environment in a particular location, with its temperature variations, wind, humidity and ground composition, all act upon a structure. It is the engineer's job to know the limits that a structure can withstand before stability and safety are compromised.

This goes beyond determining if a beam is sufficiently strong or stiff. All connections to the beam must meet certain needs, and each progressive part of the system must accommodate a large number of potential situations.

As engineers, we often use numerical models to predict structural performance early in a building's planning and design. This predictive work reduces the likelihood that the building will fail during or after construction. We want strength and safety. We do our best to account for any possible way that a building might fail. Our methods err on the side of caution. Like all numerical models, the quality of our results depends on the completeness of the data we provide and the pertinence of the assumptions we make. Recognising the imperfection



Artwork adapted from Jose-Manuel Benito, Public domain

The Cathdral of Palma de Mallorca has long mystified the architectural and engineering community by it`s impossibly thin columns and vaults. The math never added up. During one effort to reduce the weight born by the structure, conservation engineers were called in before clearing out piles of centuries-old rubble in the roof space. Who would have thought, the rubble keeps the cathedral standing!

implied in making assumptions we must ensure that these are sufficiently conservative; that is to say, they must adequately account for unknowns.

The point being, engineers sometimes have to undertake a lot of evaluation to determine something our clients feel is relatively straightforward. The models behind a reality are often complex and unique.

Many a project has included the fist-shaking frustration faced with an engineer who takes longer than desired before granting a stamp on designs. This is all the more frustrating when the request for an engineer's approval comes unforeseen, and after construction has already begun, causing a domino effect of delays.

Why can it take so long to approve something so simple? When a document is stamped the engineer assumes liability, placing their own livelihood on the line and personally bearing responsibility for life safety. Enough said.

The time saved by a hasty engineer is time not spent thoroughly understanding the calculations, assumptions and parameters behind a design. Time can be saved by not taking into account the fullest possible scope of influencing factors, most of which are not intuitive for those outside of the field.

So, what does a civil engineer do in the specialized realm of Conservation? Because the buildings already exist, rather than being designed from scratch, the engineer must take a "medical" approach.

In **the medical approach**, the engineer asseses a building as a doctor would a new patient. This means that before any work can be planned, the engineer must gather as much information as possible on the building's present state, any background on its original construction, past work and prior renovations. Ongoing problems must be distinguished from recent developments. In short, thorough diagnostics precede successful treatments. This doctor-patient approach to a building is not within the standard training of civil engineers. It requires additional study, exposure to a wide variety of historic buildings, and experience collaborating with seasoned Conservation Engineers.

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A good conservation engineer would immediately understand that an existing building is a physical model of a system. Perhaps the building seems to be barely standing, or perhaps there are significant changes to be made for future use, or perhaps even, the client wishes that nothing needed any change at all. In any case, the existing structure is the primary reference material and must be studied by inspection. A cursory look will be followed by a more probing evaluation. Intimately understanding the structure results in options for the client that are better-informed than those typically offered by a standard structural engineer. Understanding the as-is condition is required before considering remedies.

Because the engineer is typically more expensive than the contractor, it is only natural to want to minimize the use of their time. Plus, there is a real fear of what else the engineer might say. Will the engineer uncover some other problem requiring costly and immediate work? While it is possible that the engineer will bring to light something unknown to either owner or contractor, **the engineer also has the power to dispel many worries and avoid unecessary work**. As the saying goes, prevention is the best medicine.

CASE STUDY: Basement Insulation

An owner is dismayed by the prospect of needing to insulate the masonry basement of his 19th century building. The work is planned by the contractor and needs an engineer's stamp. Conventionally, the engineer can do the checks necessary to approve the design. Alternatively, a knowledgeable conservation engineer can suggest looking at the basement. Upon inspection the conservation engineer might advise that while the proposed designs are safe and could be approved, insulating the basement of this particular building will likely cause condensation, mineral and mold problems in 5 years. Furthermore, the conservation engineer can point out any relevant accommodations within the building code that may exempt the owner from having to perform what he thought was necessary work. While this service may cost a few thousand, the results can save tens of thousands or more.

QUICK FACT: The Northridge Earthquake

It wasn't until 1994, following the Northridge Earthquake, that the structural engineering community agreed that earthquakes move not only from side to side, but also up and down.

Photo credit USGS, Public domain

This publication was produced by Heritage Standing Inc. with the intention of educating and fostering discussion. If you have any questions, we would be happy to speak to you personally.