Why Concrete Needs Reinforcement

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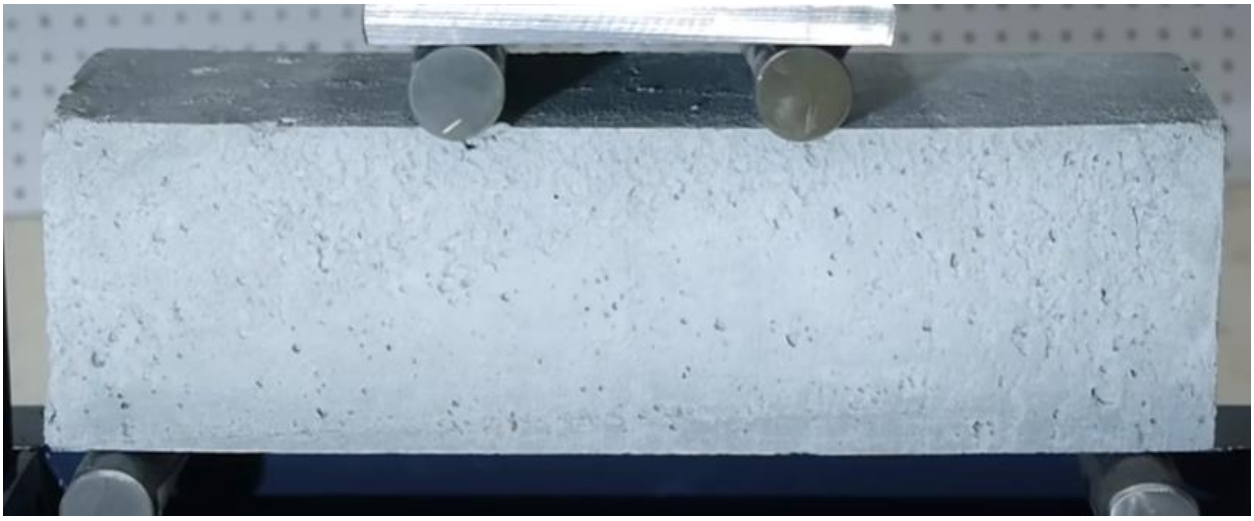
Abstract
To prove adding reinforcement to concrete will increases its strength under stress. Three beams of the same size, same structure, and same ratio of concrete but with different component inside them, were laid out. The first beam is made of pure concrete. The second beam has reinforcement casted inside. The third beam has rods tighten up inside sleeves with nuts casted inside. All of them were being tested once at a time under the press machine. Hypothesis was proven to be correct as determined with the results of the lab experiment.

Introduction
Concrete is a great construction material since we can see it occurs in every construction space. many people use concrete because of the mistaken belief that concrete is a strong composite material used for building anything, from houses to industries. Sure, concrete indeed is a super strong material. But only in a certain way. Concrete itself is very strong in taking compression stress, the stress on materials that leads to a smaller volume. But it can barely take little tensile stress(the external force per unit area of the material resulting in the stretch of the material) and it will crack instantly. So why people nowadays are still using concrete as the fundament of building construction?

In this experiment, the impact of adding reinforcement to concrete on its strength under press is being tested. Because strength against compression stress is provided by the concrete itself and strength against tensile stress is provided by the reinforcement. So, I expect concrete with reinforcement can take heavier loads.

Materials & Methods
A bucket of concrete, a beam model, a press machine, two rebars (steel rods), two sleeves, two nuts, one spanner, A tape knife are needed for this experiment. three beams of the same size, same structure, and same ratio of concrete were laid out. But for the second beam, two rebars, a common type of reinforcement made of deformed steel, was casted into the lower portion of the concrete. In the third one, two plastic sleeves were casted into the concrete before it is cured for the implementation of streel rods inside these sleeves. Once the beam cured, rods inside the sleeves were tighten up using nuts. Then, these three beams were put once at a time under the press machine and start to apply stress to the beam, keep increasing the stress until the beam breaks, and record the weight that is applied to the beams.

1. The first beam build with pure concrete



2. The Second beam that is made of concrete with reinforcement.

3. The third beam that has rods tighten up by nuts inside of sleeves.

Results

The second beam is much stronger than the first beam without any reinforcement in holding stress. Also, as shown in figure 1 and 2 below, instead of the instant cracking from the bottom in pressing the first beam, the cracks in the second beam come slowly and ductile. While the third beam is not any stronger than the second beam, it just takes more pressure for the beam to have cracks.

Figure 1: Pure concrete beam cracking.

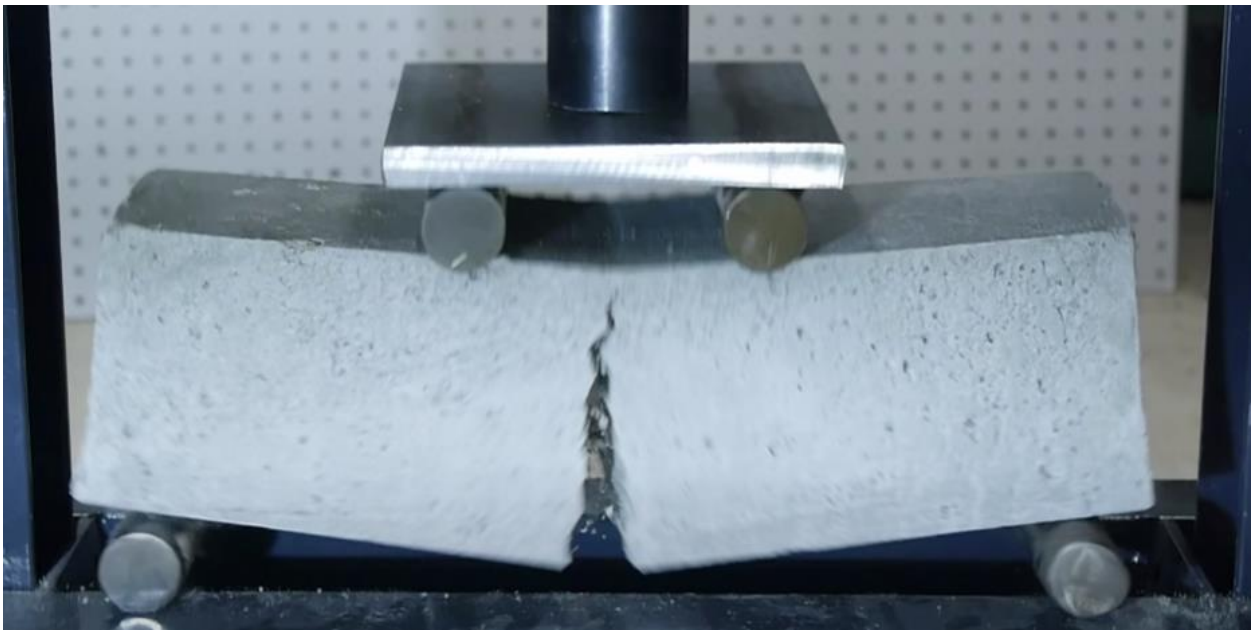


Figure 2: Reinforcement beam cracking.

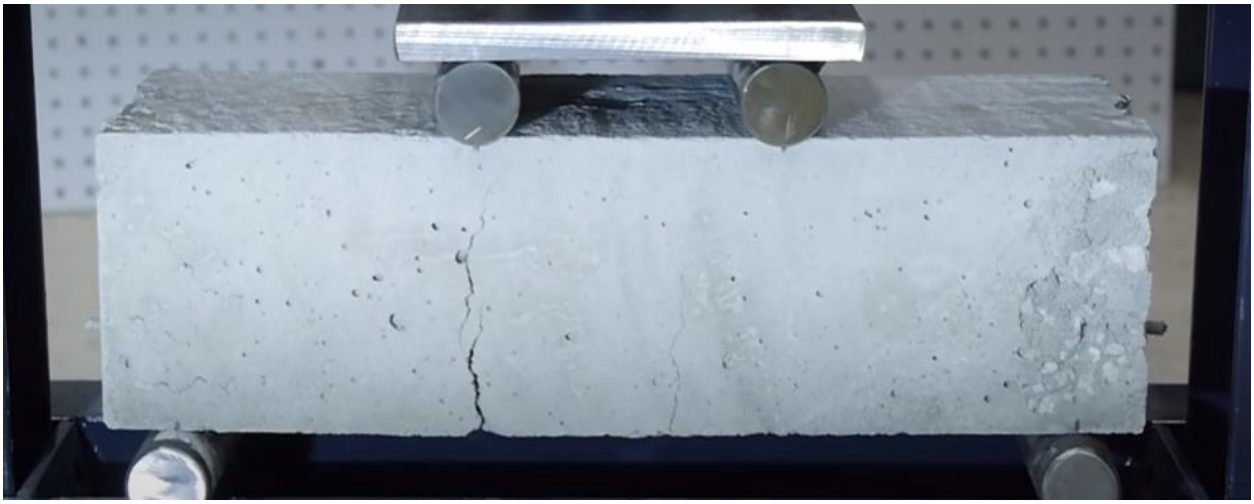
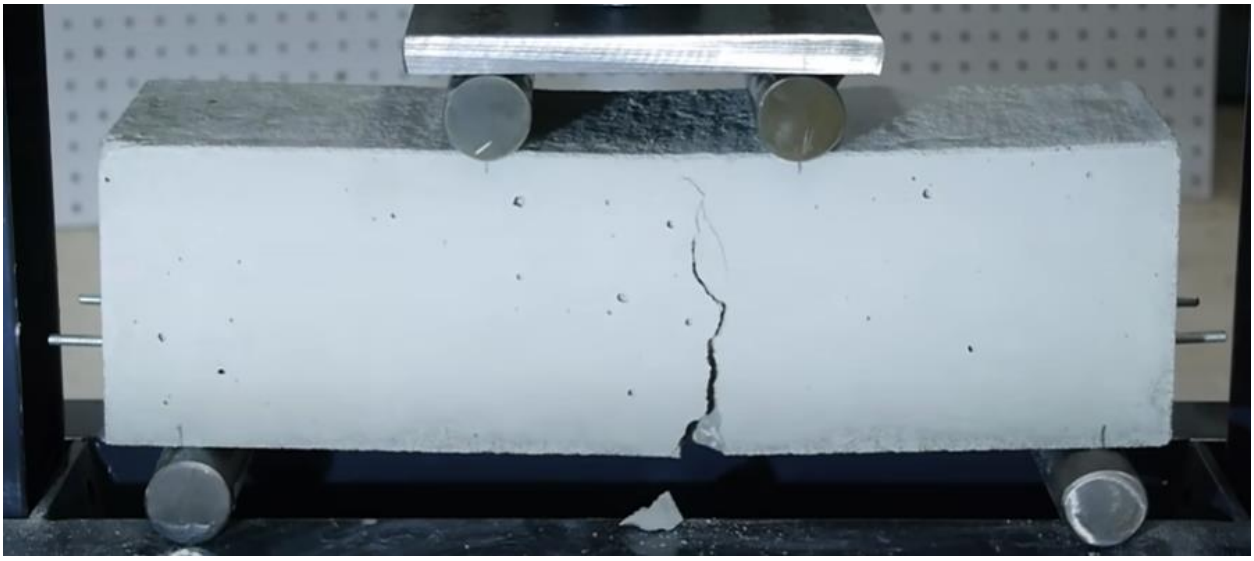


Figure 3: Sleeve reinforcement beam cracking.



Discussion

The result supports my hypothesis that concrete with reinforcement can take heavier loads. Because concrete itself is not a great structural material under press since it is strong under compression stress but weak at tensile stress. And normally when the first concrete beam is being pressed, the top will experience compression stress while the bottom is experiencing tensile stress, hence due to concrete's property, the beam cracks from the middle bottom at a brittle movement. However, for the second beam, the addition of the reinforcement is really helping the beam to take up the tensile stress because it goes through the whole beam and is placed at the bottom, the area where most tensile stresses are applied. Hence, when the stress is applied, the beam will crack, providing space for the reinforcement to take up the tensile stress. So, the second beam not only can take up heavier loads than the first beam but also, the second beam

cracks in a very ductile way, it gives people time to react and save it in real life. In addition to that, in order to avoid the cracks, we build the third beam with active reinforcement, in which we apply tension stress to the reinforcement before it is cast into the beam, so the reinforcement can start taking tensile pressure at the beginning without waiting for the beam to crack to provide it space. This operation doesn't really make it stronger than the second beam, but it does make the cracks come later. A limitation to the experiment is that beam needed to be made with same ratio concrete otherwise the experiment result might not be valid.

Figure 1: Forces that are applied to the beam under the press machine.

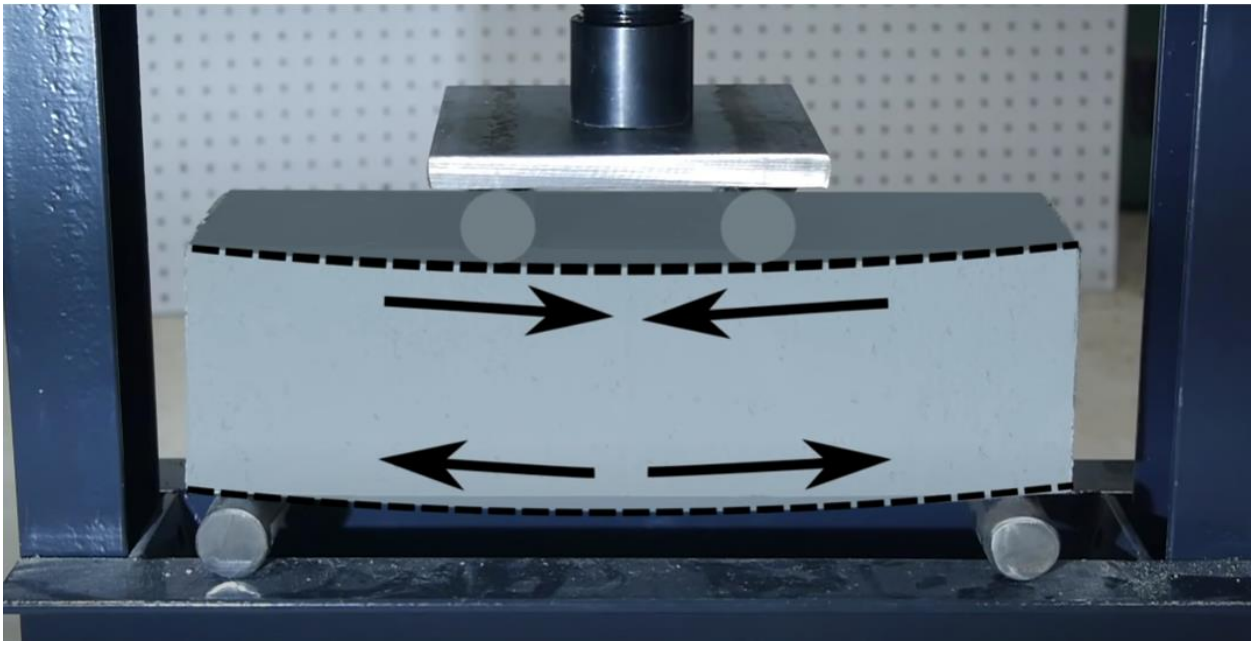
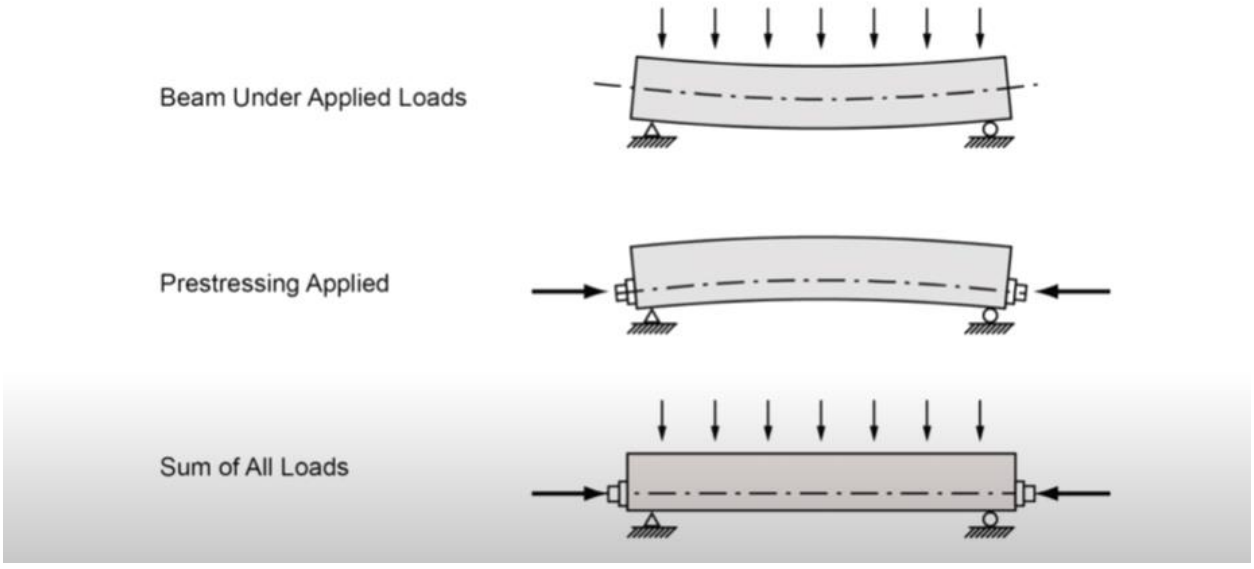


Figure 2: Active Reinforcement



Conclusion

Concrete itself is not a great structural material, although it is strong in taking compression stress it is weak at taking tensile stress, and it is brittle. This means once the building that makes out of pure concrete cracks, it will leave people with no time to react. Hence, thanks to engineers, nowadays we have different types of reinforcement cast into the concrete to make it a strong composite structural material since now it not only can take more stress than the regular beam with no rebar but also the rebar beam's cracking mode changed from brittle to ductile mode, giving people time to react on it.

Reference

“Why Concrete needs reinforcement”, Practical Engineering. [Online].

https://www.youtube.com/watch?v=cZINeaDjisY