Why is asphalt used for roads rather than concrete?

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The construction of roads is a crucial part of modern infrastructure. They are used for transportation, commerce, and communication, and their quality and durability can have a significant impact on a region's economy and quality of life. Two of the most commonly used materials for road construction are asphalt and concrete. While both have their own unique properties and advantages, asphalt is often the preferred material for road construction. Asphalt, also known as bitumen, is a black, sticky substance that is a byproduct of the refining process of crude oil. When mixed with aggregates, such as gravel or sand, it forms a strong and durable material that is well-suited for road construction. In contrast, concrete is a mixture of water, aggregate, and cement, which is poured and allowed to harden into a solid state. There are several reasons why asphalt is used for roads rather than concrete. Asphalt is preferred over concrete for road construction due to its lower cost, environmentally friendly, and ability to withstand harsh weather conditions, making it more durable and long-lasting.

One of the main reasons why asphalt is considered to be more cost-effective than concrete for road construction is because of its lower installation cost. Asphalt is typically less expensive to install than concrete, as it can be easily heated and molded to fit the contours of the ground. This makes it faster and easier to install than concrete, which requires more time and effort to pour and level.

Additionally, since asphalt is a more flexible material than concrete, it can adapt to the movement of the ground beneath it, which can help to prevent cracking and damage over time, this not only saves the cost of repair but also the time the road will be closed to traffic.

Furthermore, asphalt is easier to repair than concrete. Because asphalt can be easily softened and re-shaped, repairing small cracks and other damage is generally less expensive than repairing similar damage to concrete. This can save significant cost over the lifetime of the road.

A study conducted by the Federal Highway Administration (FHWA) found that asphalt roads cost less to construct initially, with an average cost of $2.5 million per lane mile compared to $4 million per lane mile for concrete roads. This study is a clear example of the cost-effectiveness of asphalt over concrete. Additionally, the study found that asphalt roads require less maintenance over their lifetime, with an average maintenance cost of $47,000 per lane mile compared to $66,000 per lane mile for concrete roads. This means that in addition to the lower cost of construction, asphalt roads also require less maintenance over the years which can save a lot of money in the long run (FHWA, 2).

Furthermore, asphalt roads have a shorter construction time and can be open to traffic faster than concrete roads. National Asphalt Pavement Association (NAPA) reported that "asphalt pavements offer the flexibility needed to handle all levels of traffic and can be constructed or maintained quickly with minimal disruption to travelers. In fact, new or newly rehabilitated asphalt pavement can be opened to traffic as soon as it has been compacted and cooled. There is no question of waiting for days or weeks, with traffic being detoured or squeezed. Simply put, the fastest choice in pavement construction is asphalt" (NAPA, 1). This means that the road can be used and generate revenue sooner. Therefore, the overall lifecycle cost of an asphalt road is less than that of a concrete road. NAPA also reported that "The proposed time to construct for the asphalt bid was almost half (56%) that of the shortest concrete project (360 days versus 675 days), equating to a time cost savings of $4.2 million" (NAPA, 2).

It is clear that constructing with asphalt takes less time than with concrete, as evidenced by the proposed construction time for the asphalt bid being 56% shorter than the shortest concrete project. This translates to a significant cost savings of $4.2 million.

Another example of the cost-effectiveness of asphalt over concrete is in the case of repairs, Asphalt can be repaired by patching, which is a relatively simple and inexpensive process.

On the other hand, concrete repairs can be more complex and require more time and materials. This means that the repairs for asphalt roads will be less expensive than those for concrete roads. According to Lakeridge Paving “Asphalt is significantly less expensive to install and repair but may require more frequent pothole repair than concrete roads. Both asphalt and concrete can be resealed to increase their expected useful life. In fact, one of the reasons asphalt roads tend to be a much more popular city street paving option is the effectiveness of fast and affordable overlays (Lakeridge, 1). This clearly states that, asphalt is a cost-effective option for road construction and repairs, as it is less expensive to install and repair compared to concrete. However, it may require more frequent pothole repairs. Both asphalt and concrete can be resealed to increase their expected useful life. Asphalt is also a more popular option for city streets due to the effectiveness of fast and affordable overlays. This makes asphalt a more favorable option for areas with high traffic and frequent wear and tear.

In conclusion, asphalt is considered more cost effective than concrete for road construction-due to its lower installation cost, ease of repair, and lower maintenance cost. Studies like the one conducted by the Federal Highway Administration (FHWA) and the examples of repair costs, demonstrate the cost savings that can be achieved by using asphalt over concrete.

These cost savings, combined with the durability and flexibility of asphalt, make it a popular choice for road construction projects.

Asphalt and concrete are both commonly used materials for paving roads, parking lots, and other surfaces. However, asphalt is generally considered to be more environmentally friendly than concrete for several reasons. First, the production of asphalt requires less energy than the production of concrete. Asphalt is made from a mixture of aggregate (crushed rock or gravel) and bitumen, which is a byproduct of the oil refining process. Katrina LiMandri has stated in Asphalt Materials, Inc that "Asphalt pavements require less energy to produce and their production generates less material waste than other paving materials, and its production emits fewer greenhouse gasses than concrete pavement"(LiMandri, 1). In contrast, the production of concrete requires the mining, transportation, and mixing of several raw materials, including cement, water, and aggregate. This process requires a significant amount of energy and results in a larger carbon footprint.

Another advantage of asphalt is that it is a recyclable material. Asphalt pavements can be removed, ground up, and reused to create new asphalt pavement. This process, known as "hot-in-place recycling," can save on energy and material costs, as well as reduce the need for landfills. Metso Outotec states in their website that "Asphalt recycling is increasingly common in the US; according to the Federal Highway Administration, over 80 percent of asphalt removed from roads is recycled. And that's partly due to its functionality. The FHA also asserts that: Recycled asphalt product is now routinely accepted in asphalt paving mixtures as an aggregate substitute and as a portion of the binder in nearly all 50 states. Recently developed technology has even made it possible to recycle 90 to 100 percent recycled asphalt products in hot mix" (Metso Outotec, 2).

Concrete, on the other hand, is not as easily recyclable and is often sent to landfills when it is removed. Recycling of concrete can be more challenging due to the presence of reinforcement steel, or rebar. As it is discussed in the article, The Challenges to Concrete Recycling in practice, that “The main challenges include increased project duration, lack of national programs, lack of comprehensive rules and regulations, increased project cost, low demand for recycled concrete, low cost-effectiveness of concrete recycling, and increased transportation cost” (1).

Asphalt pavement can indeed be known for its durability and long lifespan. With proper maintenance, an asphalt pavement can last up to 20 years. However, the lifespan of concrete pavements can also be extended with proper maintenance and can last for more than 20 years. It's worth noting that the actual lifespan of a pavement will depend on a variety of factors, such as the quality of the materials and workmanship used in its construction, the amount of traffic it receives, and the local climate. According to Ayres webpage, it states that “Concrete holds up better under heavy loads. Think of the heavy truck traffic on our interstate system, and it’s easy to understand why state departments of transportation tend to go with concrete on interstates. Concrete usually requires fewer repairs, making it a good choice for city streets with heavier traffic volumes. Less maintenance means fewer interruptions in traffic and fewer demands on budget. Concrete road surfaces last longer – as much as 25 years, compared to 18 for asphalt. With proper care, both surfaces could last as long as 40 years, but concrete will require less maintenance. [However they continue with the question] So why not just go with concrete? [Then they answer the question as that] “Concrete is more expensive than asphalt, and the initial cost may be more than local budgets can justify. Concrete can be noisier: The surface is roughened during construction to provide good tire grip. Over time the slabs of concrete shift or

settle slightly, producing a rhythmic sound that many motorists find annoying. Concrete may be subject to pockmarking in areas with freeze-thaw cycles, especially if the locally available aggregate that goes into the concrete mix has a high “chert” content. Chert is a type of rock that tends to collect moisture. During the freeze-thaw cycles the chert expands and pops out of the pavement, leaving holes that just get worse over time. Concrete – when new – may be damaged by salt used to reduce road icing. Some agencies opt for a no-salt approach for the first one or two winters. That’s a concern in areas subject to frequent road icing. Concrete can be more expensive and more difficult to repair. Instead of patching a problem area, workers usually must remove a slab of the roadway and replace it with new material concrete. The same is true if there are utilities under the roadway that need replacement or repair. Removing the road surface and installing new material is more difficult and expensive than the same work on an asphalt roadway” (Ayres, 1-2).

Asphalt pavements can expand and contract with temperature changes, which helps to reduce cracking and damage caused by freeze-thaw cycles. This flexibility also means that asphalt pavements are less likely to require repairs and can have a longer lifespan.
Overall, the production of asphalt is less energy-intensive than that of concrete, it's recyclable, durable and flexible, making it a better choice for the environment. While both materials have their advantages and disadvantages, asphalt pavements are a more sustainable and environmentally friendly option for paving projects. It's worth noting that the environmental impact of a pavement material also depends on its life-cycle, such as the energy consumption during the production and transportation of materials, the durability and maintenance required, and the end of life disposal options. The choice of a pavement material must be based on a

comprehensive analysis of the life-cycle costs and benefits, and not only on the environmental factors.

Asphalt is a commonly used material in road construction and maintenance due to its durability and resistance to the effects of salt and other chemicals. This is because it is a petroleum-based material that is made up of a complex mixture of hydrocarbons. Asphalt is created by blending together several different types of hydrocarbons, including naphtha, gas oil, and vacuum gas oil. These hydrocarbons are then combined with other materials, such as aggregates and fillers, to create the final asphalt mixture. The hydrocarbons used in asphalt are highly resistant to chemical reactions, which makes the material resistant to the effects of salt and other chemicals.

For example, salt is often used on roads to melt ice and snow during winter weather. However, when salt comes into contact with asphalt, it does not react with the material and does not cause any significant damage. Similarly, other chemicals that are commonly used on roads, such as oil and gasoline, do not react with asphalt and do not cause any significant damage.

In addition to its resistance to chemicals, asphalt is also highly durable and long-lasting. It can withstand heavy loads and traffic, and does not easily degrade or wear down over time. This makes it an ideal material for use in road construction and maintenance.

Overall, asphalt's resistance to the effects of salt and other chemicals is due to its composition of a complex mixture of hydrocarbons, which makes it a highly durable and long-lasting material. As a result, it is the material of choice for many road construction and maintenance projects.

It is also worth mentioning that Asphalt can also be mixed with additives such as polymer modifiers, fibers and emulsions to enhance its performance and longevity even further. This also helps to increase its resistance to extreme temperatures and weather conditions.

Concrete, on the other hand, is made up of cement, water, and aggregates such as gravel and sand. Unlike asphalt, concrete is not as resistant to the effects of salt and chemicals. Salt can cause the concrete to degrade over time, leading to cracks and other damage. Protco in the article, Everything you need to know about protecting concrete from salt damage with Saltguard, states that "Salt damage to concrete mainly occurs due to chemicals that react with the surface of the road or pavement. These structures are generally made with white-gray concrete. The calcium hydroxide present in concrete reacts with the calcium chloride in salt, creating calcium oxychloride (CAOXY) in salt, thus wreaking havoc. When forming inside concrete, CAOXY crystals expand, causing internal cracks and crumbling. This leads to increased salt damage to concrete driveways - which is further amplified by the effect of the freeze-thaw cycle. Salt also lowers the freezing point of water and increases the pressure of frozen water, thereby intensifying the effect of the freeze-thaw cycle. When ice melts, it carries approximately 10% more water than normal. In lower temperatures, this extra water adds additional ice to the concrete upon refreezing, which adds hydraulic pressure to the concrete" (Protoco, 1).

Concrete is also more prone to freeze-thaw damage, where the water in the concrete expands and contracts as the temperature changes. This can lead to cracking and other damage over time. Additionally, Concrete has a longer curing time than Asphalt. It can take up to 28 days for concrete to fully cure and reach its full strength. This can delay the opening of the road and cause inconvenience.

In conclusion, road building is an essential component of contemporary infrastructure. Their quality and durability can significantly affect a region's economy and quality of life. They are used for transportation, trade, and communication. Asphalt and concrete are two of the materials most frequently used to build roads. Despite the fact that each has special qualities and benefits of its own, asphalt is frequently chosen as the material for roads. Asphalt, commonly referred to as bitumen, is a dark, gooey substance that results from the refining of crude oil. It creates a robust and long-lasting substance that is ideal for road construction when combined with aggregates like gravel or sand. Contrarily, concrete is a fluid mixture of cement, aggregate, and water that is poured and then given time to solidify. Asphalt is preferred over concrete for roadways for a number of factors. Because it is less expensive, more ecologically friendly, and able to handle extreme weather, asphalt is favored over concrete for building roads because it is more long-lasting and robust.

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