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Academic Skills ACHA4005 Technical Report Writing

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Introduction

This Report is written to find out the different types of motorcycle frames used in the industry as well as the advantages and disadvantages of each frame to analyze which frame is overall the most desirable.

Literature Review

The first motorcycle frame used was just a bicycle called a velocipede with a two-cylinder steam engine attached to the frame made in 1823-1894 by inventor Sylvester Howard Roper, called a self-propelled bicycle or motorized cycle (Bellis, 2020). Throughout the years the frames were changed and engineered to hold larger more powerful engine as well as higher capacity fuel tanks.



(Image oA Steam powered Velocipede).



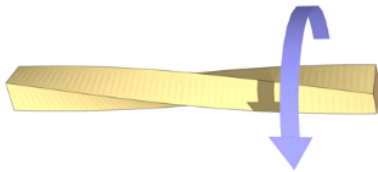
(Image oB Inventor Sylvester Howard Roper)

Discussion

1. Backbone Frame

The first frame on this list is the **Backbone Frame** made from steel this frame is the most cost effective and basic frame available, named the **Backbone Frame** as the engine hangs off the spine like structure of the frame. As said above the advantages of this frame are its cost effectiveness and simplicity in manufacturing at high numbers.

The disadvantage of this frame is it suffers from torsional movement (*movement that twist the frame off its center axis, seen in Image 1A*), lacks the strength and rigidity to carry more heavy and powerful engines as well as poor handling characteristics.



(Image 1A Torsional Movement).



(Image 2A Backbone frame)

2. Double Cradle Frame

The **Double Cradle Frames** is a type of frame that surrounds the engine with the frame or cradles it as the name suggest, made with steel tubes the **Double Cradle** refers to the two steel tubes that go underneath the engine to support the weight of the engine. This frame has more rigidity and strength compared to the Backbone Frame mentioned above as well as being cost effective and can handle more force during steeper lean angles.

This frame is **not** suitable for more performance style motorcycle as it does still suffer from torsional movement (*see Image 1A*) when put under excessive stress, the frame is also an older design by modern standards so is only usually used for cruiser motorcycle and small to mid-sized engines e.g., Royal Enfield 650.



(Image 3A Double Cradle Frame).



(Image 4A Royal Enfield 650)

3. Perimeter Frame

Number 3 on the list is the **Perimeter Frame** also known as the **Twin-Spar Frame** is a frame engineered from the ground up to accommodate high performance sports motorcycles in the racing scene, research shows that the shorter the distance from the steering head bearing to swingarm improves the rigidity of the frame significantly in turn improving handling. (See image 5A)

The two beams of the frame connect the steering head to the swingarm so need to be as lightweight as possible, originally made from steel this was found to be too heavy, so the manufacturers turned to aluminum to decrease the weight of the frame without compromising the rigidity of it.

The strength and low weight of this frame makes it a favorite for sports motorcycles, being the most common frame used by manufactures for their sports orientated motorcycles. Although having rigidity and low weight, this frame cost considerably more than the two frames mentioned above being as it's made from aluminum and harder to engineer.



(Image 5A Perimeter/Twin Spar Frame).



(Image 6A Honda CBR 1100 RR with a perimeter/ Twin Spar Frame)

4. Trellis Frame

Sharing the same design as the **Perimeter Frame**, to get the steering head bearing as close to the swingarm as possible in order to increase the rigidity of the frame, where the **Trellis Frame** differs from the example above is instead of being made from two beams of aluminum the frame is constructed using numerous small sized steel or aluminum tubes welded to each other forming a “**Trellis**” structure.

The advantage this frame has over the Perimeter Frame is increased Strength/rigidity as well as decreased weight and is simpler to manufacture/engineer in turn requiring less heavy machinery and decreasing the cost.



(Image 7A Trellis Frame).



(Image 8A Ducati Monster 1200 with Trellis Frame)

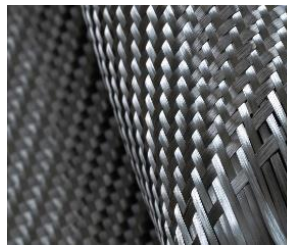
5. Monocoque Frame

Monocoque Frames used also by cars are frames that require a large amount of precise and accurate engineering as well as highly robotized production line increasing cost. Being made from one solid piece material hence the name “**Monocoque**”.

These frames are very uncommon usually only being used for hyper-motorcycles or motorcycles that are extremally powerful, these motorcycles demand incredible torsional rigidity (see Image 1A) and lightweight design. Apart from all the accurate and precise engineering increasing the cost of the frame the exotic materials used in this design also increase the manufacturing costs such as Carbon Fiber and Magnesium.



(Image 9A Monocoque Frame Used in Kawasaki ZZR 1400).



(Image 10A Carbon Fiber).



(Image 11A Magnesium)

Conclusion

With the information and research above the frames are assessed on the 4 categories **cost**, **strength**, **weight** and **engineering simplicity** to find the best overall frame.

The frame with the least amount of cost: The Backbone Frame but also the weakest frame.

The frame with the most Strength: The Monocoque Frame but is also the most expensive Frame.

The frame with the least weight: The Monocoque Frame but is also hardest to engineer.

The frame that is the easiest to engineer: The Double Cradle Frame but can't handle bigger engine sizes.

There for the best overall frame that can perform all 4 categories well is the **Trellis Frame** using good cost efficiency, excellent rigidity, decreased weight and is relatively easy to engineer and manufacture, for these reasons most manufactures use this frame on their more powerful mass-produced motorcycles.



(Image 12A Ducati Monster 900 1993 using a Trellis Frame).

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