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MOTORCYCLE COCKPIT DESIGN CLASSIFICATION: CODEC SYSTEM

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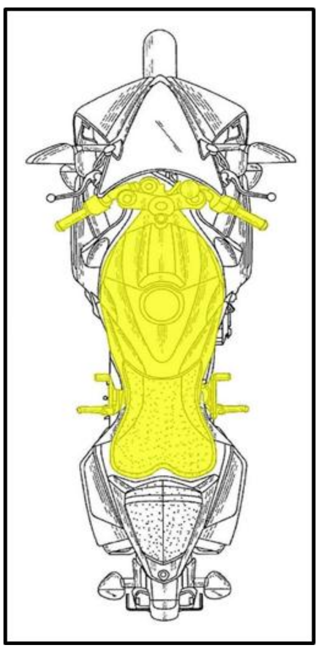
Graphical abstract



Abstract

Motorcycle have become very popular transportation nowadays. There are several ways of classifying motorcycle into different types of categories such as according to the engine displacement sizes, type, usage, mechanical function etc. Aside from manufacturer's classification, which is based on the engine displacement sizes, most of them are subjective. Due to the variations, research related to motorcycle are uncoordinated. In addition, consistency and reliability of data collected are necessary since the field of research is vast. This paper aims to fill this research gap by proposing a standardized method for motorcycle nomenclature system, which is a classification based on a motorcycle cockpit design.

Keywords: Motorcycle, test rig, Postura Motergo™, ergonomics, RIPOC system

1.0 INTRODUCTION

1.1 Motorcycle Classification System in Review: The RIPOC System

Motorcycle road accidents have become a global transportation safety issues where motorcyclists suffer mortality and non-fatal injury crashes [1]. In response to the dire motorcycle road accident statistics, researches on motorcycle were performed in various standpoints. Due to the fact that motorcycles come in various designs and specifications [2], one of the initial challenges in studying motorcycle is to accurately segregate motorcycles. Only recently, a new and ergonomics-specific motorcycle classification system was introduced. The motorcycle classification system is named the Riding Posture Classification (RIPOC) system and was established by Ma'arof and Ahmad [3]. Even so, it was found that the system is limited or only exclusive to ergonomics studies that specifically focused on the human operator. Therefore, for ergonomics studies that focused on other areas of interests – for example, on the motorcycle itself (the workstation); the RIPOC system is extremely challenging to be utilized. Therefore, there is a gap for the development of a motorcycle classification system that is with respect to the motorcycle (the workstation) from the perspective of ergonomics.

1.2 Motorcycle Cockpit

The motorcycle cockpit is defined as the platform or the location on a particular motorcycle where the human operator (the motorcyclist) will be positioned in order to operate the motorcycle i.e. performing the motorcycling activity (the work). As shown in Figure 1, the motorcycle cockpit is highlighted in yellow.

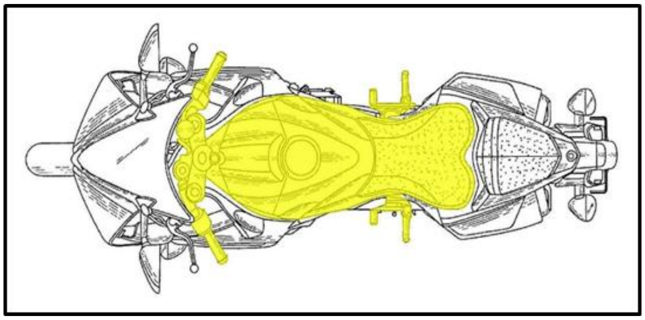


Figure 1 The motorcycle cockpit

During the preliminary studies, it was observed that motorcycles come with various cockpit designs. Even so, from a general perspective, a motorcycle cockpit is made up of three major parts. The major parts are (i) the handlebar station, (ii) the structural body, and (iii) seat/seating platform.

1.2.1 The Handlebar Station

(a) (b)

Figure 2 (a) Harley Davidson FLHX Street Glide [4], (b) Kawasaki Z800 [5]

The handlebar station here represents a collection of motorcycle parts which are needed in order for the human operator to control and manoeuvre the motorcycle. Examples of the components are the triple clamps, top yoke and handgrips. In addition to the aforementioned components, the handlebar is also normally equipped with other means of components such as levers, controls and gauges which are needed to operate the motorcycle. The levers, controls and gauges commonly differ between one motorcycle and another. Some motorcycle may even be integrated with a full dash panel or instrument panels which has strong resemblance as the ones integrated into cars (see Figure 2 (a)), whilst, some chose to be simpler and conservative (see Figure 2 (b)). Examples of the levers, controls and gauges are as summarized in Table 1.

Table 1 Example of levers, controls and gauges commonly integrated to a motorcycle at the handlebar station

Levers	Controls	Gauges
Front brake lever	Traction. control	Speedometer
Clutch lever	Power modes	Fuel indicator
-	Wheelie control	Temperature indicator

1.2.2 The Structural Body

(a) (b)

Figure 3 (a) Yamaha V-Max [4], (b) SYM 250 [6]

The availability of the tank cover is dependent on the motorcycle's chassis design variants. The component or structure that connects the steering head with the seat (or even engine) could be anything from a beam/truss design to a structural airbox. Even so, for as long as the structure is located between the steering head/handlebar station and seat/sitting platform/engine, in this study, this chassis design attribute is named as an upperbone cockpit design. For this design attribute, the tank cover is presents. Contrastingly, in referring to Figure 3 (a) and (b), in contrast with Figure 3(a) the steering head for motorcycle in Figure 3(b) is connected with the seat/sitting platform via a structure that makes an "L" shape before connecting to the two components. This sort of chassis design attribute is commonly known as underbone chassis design. For this design attribute, the tank cover is absent. The motorcycle in Figure 3(a) is an upperbone motorcycle.

If the tank cover is present, this section of the motorcycle commonly houses the fuel tank. Nevertheless, this also varies with manufacturers and motorcycles designs, for example the 2014 Yamaha V-Max (see Figure 3(a)). If the fuel tank is not located in this location, the fuel tank is most probably located under the seat – a very common design principle applied for an underbone chassis motorcycles such as the SYM 250 shown in Figure 3(b). Therefore, the motorcycle's fuel tank positioning is not entirely influenced by the chassis design. The fuel tank is usually dependent on the overall motorcycle design purposes. Design wise, by placing the fuel tank under the seat, this lowers and centralize the motorcycle's centre of gravity towards the middle section of the motorcycle. This would facilitate in ensuring the motorcycle's stability, while simultaneously improves its handling.

1.2.3 The Seat/Sitting Platform

The seat/sitting platform is the location where the human operator would be seated. Almost all road going/road-legal motorcycles come with a seat/sitting platform. The seat designs vary with respect to motorcycle designs. Generally, almost all road going/road-legal motorcycles do not come with a full-backrest. Even so, certain motorcycle designs such as the SYM 250 comes with a lumbar support (see Figure 3 (b)). The sitting platform is also incorporated with feet supports for the human operator to place his/her feet. Dependent on the motorcycle design the feet supports could be as simple as foot-pegs (see Figure 4 (a)), foot-boards (see Figure 4 (b)), or a full support platform (see Figure 4 (c)).

(a) (b) (c)

Figure 4 (a) Foot-pegs [7], (b) Foot-boards [8] and (c) Platform [7]

In short, a motorcycle cockpit is the location where the human operator would be positioned to operate a motorcycle. It varies in design and thus, varying the areas of physical surface contact made with the human operator. The varying characteristics with respect to the motorcycle cockpit designs could be utilized as a foundation for the development of a workstation based motorcycle ergonomics classification system. Therefore, this could then fill the research gap provided by the RIPOC system.

1.3 Motorcycle Cockpit Design Classification System

This study introduces the Cockpit Design Classification (CODEC) System.

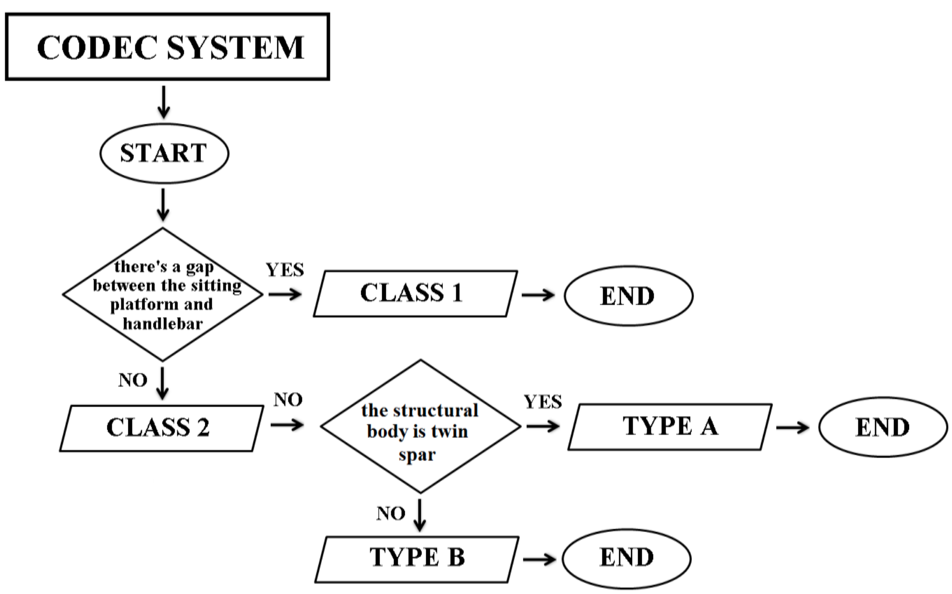


Figure 5 The cockpit design classification (CODEC) system

The CODEC is a motorcycle classification system that segregates motorcycle with respect to the motorcycle cockpit design. The CODEC utilized a simple assessment chronology in classifying the motorcycles as shown in Figure 5. As shown in Fig. 5, the initial step is to identify if there exists a space or gap between the sitting platform and the handlebar. The purpose of this procedure is to identify the structural body design types of the particular motorcycle. If there is a gap or space between the sitting platform and the handlebar, thus, the motorcycle is denoted as Class 1 motorcycle. The Class 1 motorcycle has an underbone type of structural body design. Contrastingly, if there is no gap or space between the sitting platform and the handlebar, thus, the motorcycle is denoted as Class 2 motorcycle. The Class 2 motorcycle has an upperbone type of structural body design and is further divided into 2 types. For the structural body design where the structure is a twin spar structural body i.e. the structure is wide and expanded (see Figure 6 (a)), the motorcycle is classified as a Type A of Class 2 motorcycle. If the structural body design is single spar structural body (see Figure 6 (b)), then, the motorcycle is classified as a Type B of Class 2 motorcycle. Figure 6 gives examples of motorcycles that are categorized within these classes of CODEC.

(a) (b) (c)

Figure 6 (a) a Class 2 Type A cockpit design motorcycle, the motorcycle featured is the 2012 Yamaha YZ-F R1 with, (b) a Class 2Type B cockpit design motorcycle, the motorcycle featured is the 2014 Yamaha Stryker, and (c) a Class 1 cockpit design motorcycle, the motorcycle featured is the 2012 Yamaha Zuma 125 [4]

There are significances in the development of a motorcycle classification system that is with respect to the motorcycle (the workstation). The details are as follow:

Firstly, as of November 2014, the only motorcycle classification system from the perspective of ergonomics is a human operator based classification system. Motorcycles are segregated with respect to the riding postures practiced by the human operator. Therefore, this motorcycle classification system is exclusive only to studying the human operator (the motorcyclist) from the standpoint of ergonomics. Hence, with the development of the CODEC system, a new motorcycle classification system with respect to the workstation (the motorcycle) from the standpoint of ergonomics was established. This is something new with respect to the pool of motorcycle ergonomics knowledge.

Secondly, critical analysis on motorcycle's design (workstation design) with respect to ergonomics could be performed more scientifically. Via the CODEC system, the design parameters of a motorcycle (as a workstation) could be acknowledged and determined more scientifically and its relation with the human operator could be examined. For example, the measurement of certain elements of the cockpit (such as the distance between the sitting platform and handlebar) could be determined and then linked with the resulting riding posture which needs to be practiced by a particular human operator. Such linkages of information are vital in integrating greater ergonomics value with respect to motorcycle cockpit's designs (workstation designs). This is vital in further pushing the knowledge frontier of motorcycle ergonomics.

Finally, in-depth study on human and motorcycle interface could be performed more systematically. From the CODEC system, it is clear that varied motorcycle cockpit designs would result in different physical interfaces between the human operator and the motorcycle. Thus, the CODEC system ensures the accurate segregation of the motorcycles. This in return would facilitate in studies with relation to the physical interface i.e. the physical contact between the human operator and the motorcycle.

In addition, the CODEC system presented several advantages as a motorcycle classification system. The advantages of the CODEC system are as follow: (i) the CODEC system is applicable for any past, present, future motorcycles. The motorcycle engineering principal used by the system i.e. the motorcycle cockpit designs, could withstand the test of time, (ii) the CODEC system utilized a simple and straight forwarded procedure in segregating motorcycles, (iii) the usage of the CODEC system does not require the need for any in depth knowledge on motorcycle, and (iv) the CODEC also treats the motorcycle as a workstation – a concept mentioned by Robertson and Minter [9].

In short, the CODEC system is a unique motorcycle classification system. The CODEC system was established from the perspective of motorcycle (the workstation), yet, still having stronghold on ergonomics because the cockpit (the focus of the CODEC system) is in direct physical contact with the human operator. Hence, it is an ergonomics-oriented motorcycle classification system. The CODEC system provided a different perspective than the currently existing ergonomics-oriented motorcycle classification system

2.0 CONCLUSION

This study introduced a new motorcycle classification system from the perspective of workstation which is the CODEC (Cockpit Design Classification) system. CODEC system is applicable for all existing and also future motorcycles models. The CODEC system allows for greater understanding and appreciation of motorcycle designs features. This is essential since hypothetically, the differences in cockpit designs would affects the human operator's method and limitation in controlling and manoeuvring the motorcycle. Thus, suggestively, affecting the overall safety level in utilizing the particular motorcycle. Ergonomist and researchers alike could look into this factor in designing and analysing motorcycling safety. CODEC system could definitely aid researchers especially in motorcycle ergonomic niche area in treating motorcycle as workstation.

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