LE CORBUSIER AS A CAR DESIGNER

ABOUT HOW HIS ARCHITECTURAL BACKGROUND INFLUENCED HIS AUTOMOTIVE DESIGN

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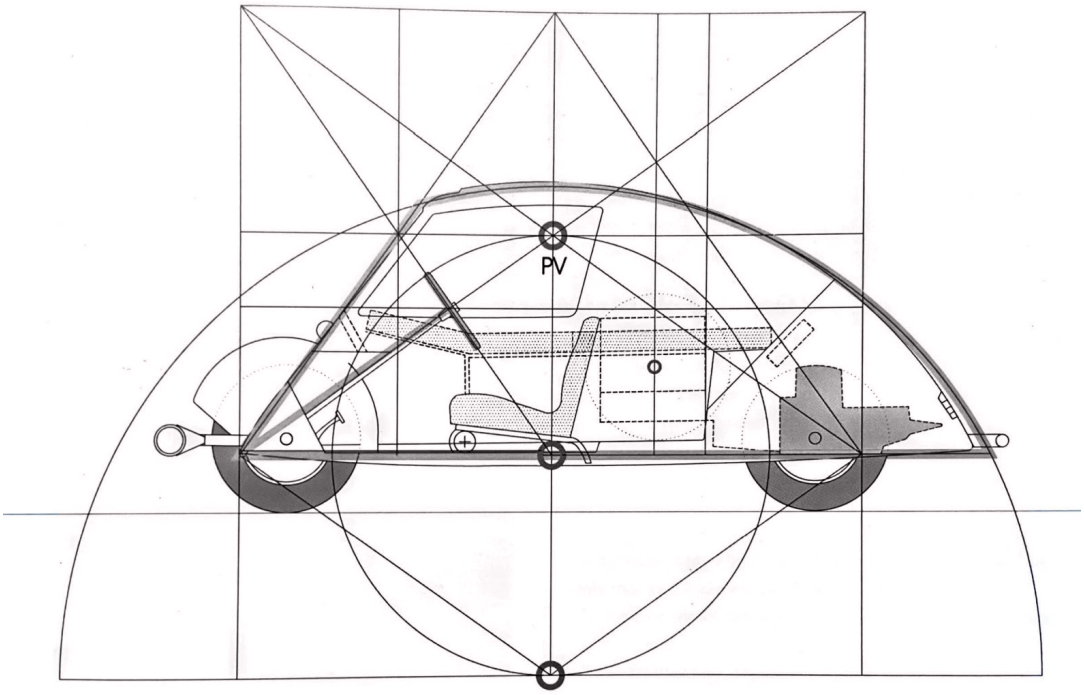

√2 modulation analysis on section of Voiture Minimum

HISTORY THESIS

On how Le Corbusier’s architectural vision and background influenced his automotive/industrial design; The Voiture Minimum

Fig 1 (Front cover). √2 modulation analysis on section of Voiture Minimum done by Manuel Franco Taboada.

Note. Taken from “*Voiture Minimum: Le Corbusier and the Automobile*” (p. 235) by A. A. Lorenzo, 2011, Amsterdam University Press, Amsterdam. Copyright 2011 Amsterdam University Press

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INTRODUCTION

Le Corbusier was not only into Architecture, but one could argue that he actually was more interested in automotive design. That was mainly due to their perfected standardisation for mass production purposes. It was a big inspiration for him as an architect, initiated by Henry Ford with the Model T. Le Corbusier's fascination with car design resulted in him even entering an automotive design competition with his cousin, creating his ideal version of cheap car design; the Voiture Minimum (Lorenzo, 2011). His architectural influence and designs have been widely studied and several studies mark him as one of the most revolutionary architects in modern architecture. His automotive design however, has not seen any of the same amount of publications. It is mostly seen as only a small footnote to his career, in contrary to the opinion of Le Corbusier himself as will be further explored.

As mentioned before, there has been a lot of literature about how automotive design and engineering were of great influence on Le Corbusie's architecture. This automotive influence on architecture is for example mentioned in the book 'From Autos to Architecture' (D. Gartman, 2009). Here he studies the Ford Model T and the Fordist way of production as exemplars of modern architecture. He describes how Le Corbusier was impressed and influenced after he visited the production plant. Le Corbusier also clearly shows this in his own book 'Vers une architecture' where he explains how he sees the engineering of contemporary car design as the modern showcase of the architectural perfection achieved with the Parthenon (1923, p. 133). This all leads to him advocating for architecture to move on and progress as well. In addition to this influence from the car to Le Corbusier, there has been written a book which explores his automotive design separately (A. A. Lorenzo, 2011). This mainly focusses on technical drawings and dives deep into the date of origin of the design itself. These books however only describe the automotive influence on his architectural vision or purely focus on the industrial design of the car itself.

There has been almost no literature questioning how his architectural ambitions are translated into his automotive design. This research hopes to fill this gap of knowledge. This link has barely been made before, as most literature mentions the automobile from an architectural point of view, neglecting the influence the other way around. So the main research question I want to answer is:

"How much did Le Corbusier stay true to his architectural vision and interest for his automotive/industrial design; The Voiture Minimum?"

To answer this question, the first chapter focuses on generally linking automotive design and architecture to see how they can be related. In addition to that, the connection between Le Corbusier and the car is explored as well to create an understanding of his interests. The second chapter dives into his book "Vers une architecture" to understand and define his architectural vision in order to be able to compare this to his automotive design. This is done in the third chapter, where the design process is analysed to be able to see how his vision and background can be seen throughout his automotive project and linked the two together. Then in the fourth chapter, it is briefly explored how his design differs from other car designs from the same period, to see how his design is stacked up with well-known car designs.

This paper is mostly based on research into already known literature, but then linking the two disciplines by using the Voiture Minimum as a case study to add new insights on how Le Corbusier his architectural way of thinking influenced his car design.

H1: LINKING AUTOMOTIVE DESIGN, ARCHITECTURE & LE CORBUSIER

At first glance, the similarities between automobile and architectural design are minimal. Apart from the regulations, architects are free to take a unique approach in each case that results in a completely unique design. The automotive sector operates in quite the opposite manner. Every design is based on complex regulations with strict guidelines, resulting in a production version of a car which then will be produced in large number of units. Car design evolves over time, without reference to the distant past, traditions, or ties. This is due to the industry's short history and the need to constantly compete and advance in order to remain relevant in the market. Architecture, however, has evolved linearly, from style to style, with sporadic minor incremental influences. There is always the chance to look back at references for ideas and inspiration (Martin Pawley, 1990)

However, because they value aesthetics, architects are often drawn to the field of automotive engineering and the advancement and effects of technology on design. Due to industrial design becoming recognized as a separate field of study in the late 1920s, architecture began to lose its position as the mother of the arts. Automotive design has since then been one of the most progressive disciplines based on the evolving needs of car use. Many architects over time have tried to create automotive designs, which have been explored by I. Margolius in his book "Automobiles by architects". He argues that architects often saw the car as a perfect opportunity to reclaim their all-around creativity in order to keep up with the evolving conditions of design (I. Margolius, 2000).

On top of that, the automotive industry also has drawn much inspiration from architects over the years. This in a large part because of their adaptable and receptive design philosophy. Renzo Piano, for instance, was asked by Fiat in 1978 to help with some of their design issues and to contribute fresh concepts to the company's growth (Lorenzo Ciccarelli, 2018). The car industry can sometimes be too comfortable in the direction they go, until an outsider disrupts the discipline, leading to a big transformative leap. Similarly to how most recently has been demonstrated by Tesla, Ford also revolutionized the automotive industry in the 1900s.

In 1913, Ford transformed and revolutionized the productions of cars and later the whole industry by introducing the moving assembly belt making quick and cheap mass-production possible. To make this possible they designed the Ford model T, a fully standardized car for the masses. Le Corbusier was greatly inspired by this, as it supported his predictions about the future of cities, the mass production of houses and the importance of cars. (D. Gartman, 2009). Le Corbusier was a renowned speaker by the 1930s, and he received invitations from all over the world. He travelled to the US in October 1935, just before he entered his own automotive design to the SIA competition. When he arrived in Detroit, he asked for a tour of the Ford factory, where they originally mass produced the Model T. He was captivated by the powerful experience of watching a new car leave the Ford assembly line every 45 seconds. He said: "I am immersed in a type of astonishment," (MIT Press, 2001, p. 102.).

His fascination for automobiles can be seen throughout his whole life and architectural career. He designed whole city plans based on extensive reliance on the use of cars. He then tried to work together with automakers to make these plans into a reality. His plan Voisin, his masterplan for Paris, for example is subsidized by the automotive manufacturer Voisin . For his own architecture, he also paid very close attention to how the automobile and the house reacted to each other. He even insisted that all of his buildings should be photographed with a modern car in the foreground to demonstrate this relationship. This was often his favourite modern car, the Voisin C4. He loved this car for it's modern aesthetics due to its simple plan and design. On top of that, and probably not a coincidence, it had been designed by his friend and architect André "Noël-Noël" Telmont (I. Margolius, 2000).

Another well known example of this connection between architecture and the automobile can be seen in his Ville Savoye. Here Le Corbusier emphasized the direct link between modern automotive use and the new architectural aesthetic. The building is elevated with space for a car to circulate and park under the building on the ground floor. This motion is then continued via a ramp, leading trough the house to a roof garden. Here he designed framed views over the garden, as if it is seen through a car window".

As presented here, throughout Le Corbusier his career, there are many elements showing his obsession for the automobile. We can see it in his town planning, where the car was his way of connecting different parts of his perfect city. We can also see it in his architecture itself, in the way how he integrated the use of the car into his designs, like Ville Savoye, but also in the way he approached designing the perfect house. On top of that, it has been ultimately been confirmed by the fact that he even ended up designing his own version of a car. To understand how his automotive fascination could have been combined with his architectural vision, the next chapter will summarize and define his architectural vision in order to be able to compare this to his automotive design; the Voiture Minimum.

H2: LE CORBUSIER'S VISION ON ARCHITECTURE

As was mentioned in the previous chapter, Le Corbusier believed that at his time, automotive design had far out developed architecture as a design discipline. During World War I, technological innovation made a significant advancement. In order to inspire new architects and to revitalize architecture, he often wrote his theories down in manifestos. In 1923 he published a book "Vers une architecture" in which he combined all these manifestos, containing his entire theory of architecture. With this book Le Corbusier aims to put the architect back in the spotlight as the driving factor behind creating this new world. A new architectural order is something he wants to establish. It went on to become one of the most influential Architectural written works since then. The book marks the beginning of the architect Le Corbusier, collecting his ideas and analyses from earlier years serving as a sort of foundation for his version of modernism in architecture.

Since the first translation in 1927, the known English title has always been "Towards a New Architecture". This translation however, has generated some controversy as parts of the book had been altered to the translators ideas and opinions, putting focus on the added word 'new' in the title. It emphasises that Le Corbusier wanted a new set of technologies as well as new aesthetics inspired by cars, boats, and bridges, but neglects his focus on the fundamental design principles he listed which were inspired from classical antiquity. This changed in 2007 when John Goodman released a new translation that was both more accurate and faithful to the original and reinstated the original title (L. Martin, 2021).

Le Corbusier's architectural vision summarized

In order to create an understanding of his architectural vision and to be able to define it, this chapter summarizes and compiles his visions from his book "Vers une Architecture". To stay as true as possible to the original, the translation from 2007 has been used (L. Corbusier, 1923/2007). Le Corbusier orients his book towards new architects. It is like a rulebook about how he aims to perfect architecture. He starts with the chapter 'Three reminders to architects'. Here he focusses on how architects should define mass, surfaces and plans of architectural design. After this he explores how machines of that time, namely ships, airplanes and cars have evolved to a perfected machine aesthetic.

To make the comparison as clear as possible, the following chapters of this paper have been kept to a similar structure as his book; Mass, surface, plan, order and the machine aesthetic.

Mass

For mass he argues to stick to the primary forms; cubes, cones, spheres, cylinders or pyramids, as they reveal their shape with light and shadow in a most simple and tangible way (Fig 2). Primary forms are beautiful because they can be easily understood. He uses Egyptian, Greek and Roman architecture as great advocates for this principle. Other forms of architectural design do not belong to architecture in his opinion. Where architects struggle to create simple shapes, engineers employ geometrical forms based on the use of calculations. They know how to please our eyes with their geometry and our minds with their mathematics; He rates their work similar to high-quality art.

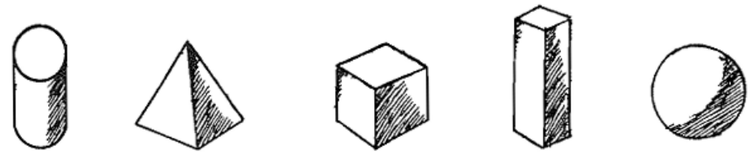

Fig 2; Sketch of basic shapes by Le Corbusier

Note. Taken from "*Toward an architecture*" (p. 200) by L. Corbusier, 1923/2007, Getty Research Institute LA, Calif. Copyright 2007 Getty Research Institute

Surface

From the mass he goes to its envelope, the surface. He argues that the surface must tightly clothe the base masses, without overruling it. So the surface must be adopted to the mass and be based on the function. Regulating lines can then be used to create order and individuality. These must act as an accentuation of the form. He seeks the answer to the problem of design in a pure geometrical solution.

Plan

He then ends with the plan, which to him is the generator of any design, mass and architecture. Without a plan, any architect will be disorganized. There can be no aim and concept, nor rhythm or any form of coherence without it. He argues that for the plan the most imagination is needed, as it needs to react to its functional needs with a mathematic inspired design.

Order/regulating line

The regulating line is something he keeps coming back to. All his favourite designs and plans are governed by elementary mathematical calculation. Order is being imposed by means of measurement. He argues that the regulating line introduces this form of measurement, which then fixes a reassuring perception of order and geometry. Architecture should be easily able to be divided into its underlying shapes, as can be seen by his sketch on The Porte Saint-Denis (Fig. 3). The regulating line was frequently based on the human scale and proportions, as their need was the main

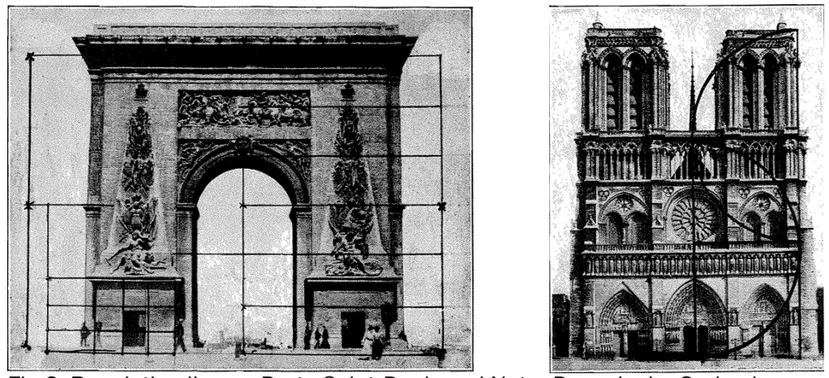

Fig 3. Regulating line on Porte Saint-Denis and Notre Dame by Le Corbusier

Note. Taken from "*Toward an architecture*" (p. 131,139) by L. Corbusier, 1923/2007, Getty Research Institute LA, Calif. Copyright 2007 Getty Research Institute

requirement for the design. It is therefore vital that the architect has a moment of inspiration when choosing its regulating line. According to Le Corbusier, geometry should be the main language of all architects.

Machine aesthetic

The next three chapters, he dedicates to advocate for a more true and progressive architecture, for a pure understanding what architecture stands for. He uses the engineers and machinery of his time as an example of perfected design. He is fully aware that engineers have up to this point dominated the construction methods used in the new world. The Eiffel Tower for example, the then tallest structure in existence, was created by an engineer. Machines have an economic factor in themselves, making for selection and competition to move forwards. He argues that architects must first of all aim to set up standards, in order to be able to achieve a state of perfection. Without any form of unnecessary decoration, as he even calls architecture out for being in a diseased state in which art and mere decoration are mixed up. Ocean liners, for example he argues, are perfected over time due to their respect to nature and their pure function. As was the same for the airplanes of the time. Competition and a specified need, made it possible for those designs to progress into a perfected state. Their construction had become part of the design and served an integrated aesthetic function, which he argued should also be the aim for architecture.

In the third chapter he focusses on then contemporary automobiles. He starts with comparing the Parthenon to the automobile, as he argues that they are both examples of designs standardized to their own state of perfection. They are organized by rational elements,

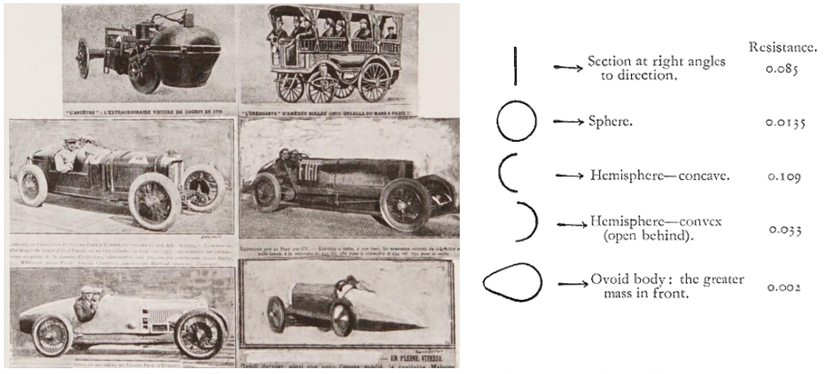

Fig 4. Evolution of car design based on aerodinamics

Note. Taken from "*Toward an architecture*" (p. 190) by L. Corbusier, 1923/2007, Getty Research Institute LA, Calif. Copyright 2007 Getty Research Institute

following a line of direction, the regulating line. For the automobile the perfected standard has come from taking inspiration of aerodynamics, nature. He demonstrates this in a simple comparison diagram (Fig. 4), showing that the ovoid and simplified shapes of cars have a functional purpose and thus have become aesthetically perfected. He states: "If the problem of the dwelling or the flat were studied in the same way as a chassis is, as speedy transformation and improvement would be seen in our houses. Sane and defensible forms would appear from mass production, and a new aesthetic would be formed with astonishing precision" (Le Corbusier, 1923/2007, p. 179).

His vision was grounded in his belief that architecture should be perfected to a standard which is functional, rational, and efficient and guided by direct needs. It can be summarized in the following elements;

- The plan is the generator of any design concept, rhythm and coherence. It is the start of any architecture and is based on the function and mathematic inspired measurements.
- The mass should be made up of the primary forms; cubes, cones, spheres, cylinders or pyramids as they are easily understood and therefor beautiful.
- The surface must reflect the massing and the function. An order had to be achieved by creating regulating lines.
- Order, proportion and harmony can only be achieved with the use of a regulating line. The regulating line brings in a form of fixed measurement.

With these elements, it is possible to compare his architectural vision to his automotive design in the next chapter.

H3: THE VOITURE MINIMUM DEFINED

For this next chapter, the previously established characteristics for Le Corbusier's architecture will be used to analyse his automotive design. Namely; plan, mass, surface, order followed by some more general similarities between Le Corbusier his architectural vision and his automotive design. All the sketches and pictures used for this analysis can be found in the Foundation Le Corbusier archive, in Paris. They are scanned in by A. A. Lorenzo for his book (2011). In order to be able to understand the design of the Voiture Minimum, firstly a short introduction on how it came to be.

SIA

The Voiture Minimum started as an automotive design proposal, created by Le Corbusier and his cousin Pierre Jeanneret, published in April 1936 as an entry for a design. The French Society of Automotive Engineers (SIA) established the "SIA Automobile" design competition in 1927 with the intention of promoting innovation and excellence in automobile design. The automotive industry at the time was expanding quickly, and new and creative designs were required to satisfy shifting consumer demands. France had lost its position as the industry leader, and this competition should help restore France's status as a hub for automotive design and innovation. Only members of the society were allowed to participate, and design submissions had to follow strict technical specifications. The idea was to create a two-person, small, and inexpensive to operate car for the general public. The design proposal of Le Corbusier and his cousin, did not meet all of the requirements and was handed in after the closing date. This mend it was not legible for prizes, however Le Corbusier felt this was an opportunity to show his design skills in a different discipline (B. McGuire, 2018).

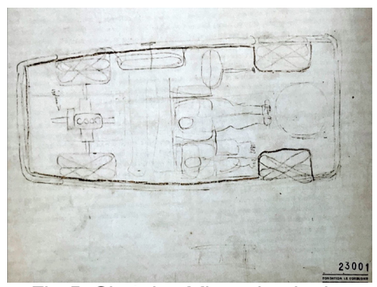

Fig 5. Sketch of floorplan by Le Corbusier

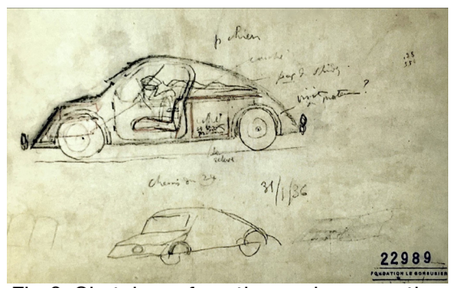

Fig 6. Sketches of section and perspective by Le Corbusier

Note. Both taken from "*Voiture Minimum: Le Corbusier and the Automobile*" (p. 176, 179) by A. A. Lorenzo, 2011, Amsterdam University Press, Amsterdam. Copyright 2011 Amsterdam University Press

Plan

A first comparison can be made with the approach which Le Corbusier took at the start of the design process. Like with his architecture, he saw the floorplan as the fundamental part of the design of the Voiture Minimum. As can be seen from the sketches he made, following the sequence established by A. A. Lorenzo (2011), he started with a floorplan as the generator of the concept, see sketch 23001 (Fig. 5). The main characteristics are sketched and proportions are based on human scale with the intended functions in mind. Instead of designing a complex, moving object, he designed it in a way like he was designing a small, simple building. After the plan, he made the first outside sketches and sections. They were all also in a 2d, orthogonal view, like any architectural elevation.

The functions he envisioned, show also how he saw it more as a mobile living space. For example, in sketch 22989 (Fig 6), he shows the potential for the front seats to be transformed into a bed. In this way, the passenger could even rest while traveling, which in turn fits to his vision of the ideal city where night travel is part of the norm. In addition to that, he went away from the normal two front seat configuration, but created a three wide seating arrangement with additional space for luggage and a spare wheel. The width of these three front seats were also his way of determining the minimum width of the car, so the internal function was the leading factor in this. With three seats of 45cm plus the body, this came down to a 1.80m wide car (K. Smith, 2015). This is wide for that time and especially for a small city car. However, this again fits his vision of the ideal city with wide and long freeways.

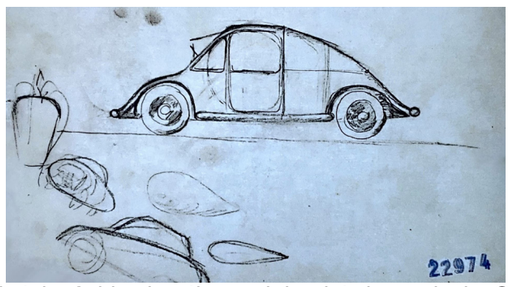

Fig 7. Sketch of side elevation and droplet shapes by Le Corbusier

Note. Taken from "*Voiture Minimum: Le Corbusier and the Automobile*" (p. 180) by A. A. Lorenzo, 2011, Amsterdam University Press, Amsterdam. Copyright 2011 Amsterdam University Press

Mass

As mentioned before, from the beginning of his architectural career Le Corbusier was always fascinated by the basic geometric forms and the underlying geometry used in classical architecture. In early stages of his automotive design, it looks like he neglects this quality, as he focusses more on aerodynamics. This fits to the then contemporary trends, as early 1930's car designs started to evolve from horse carriage based designs to more organic shapes based on aerodynamics. Also, as can be seen on drawing 22974 (Fig 7), Le Corbusier sketched droplet like shapes, evolving it into a car elevation sketch. This links to the remarks he made in his book, as he there argues for a fixed standard of car design ranging from ovoid body with the greater mass in front for a fast car to a comfortable car with the larger volume to the back.

However, for the Voiture Minimum he did not use this. The car had been designed to provide the best comfort for a small car, which then should result into a rear focussed design, like a limousine in contrary to the front heavy design it has become. So representing the function, which Le Corbusier always deemed necessary for good architecture, was neglected for his automotive design. The American specialist and writer Phill Patton, specialist in historical automotive design, takes the dishonesty of the design even a step

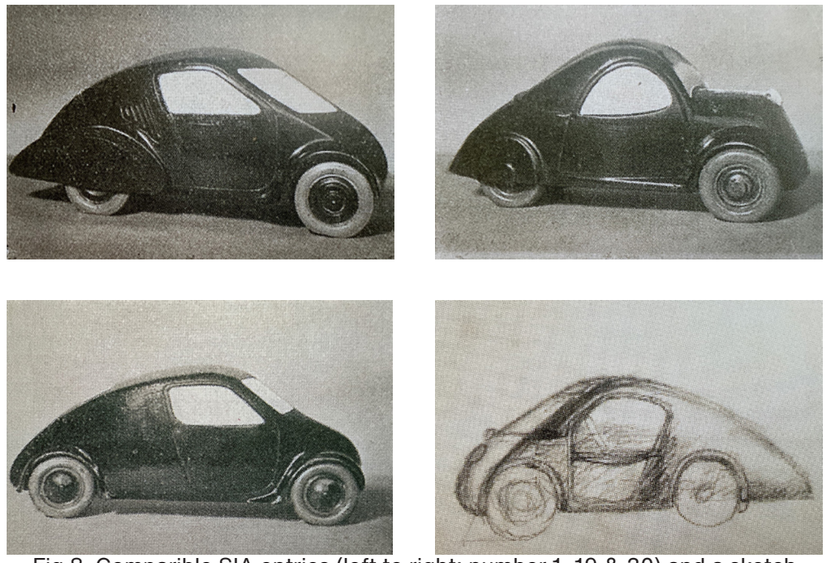

Fig 8. Comparible SIA entries (left to right; number 1, 19 & 30) and a sketch perspective by Le Corbusier of the Voiture Minimum

Note. Taken from "*Voiture Minimum: Le Corbusier and the Automobile*" (p. 169, 170) by A. A. Lorenzo, 2011, Amsterdam University Press, Amsterdam. Copyright 2011 Amsterdam University Press

further in his book "Theory and Design In the First Machine Age". He argues that if Le Corbusier tried to design for aerodynamics, he should have utilized organic shapes to minimize air resistance as done by other designs for the SIA (Fig. 8) (Banham, 1960). Le Corbusier, however, opted to use straight and angular surfaces, resulting in more of a boxy shape which does not reflect either speed or comfort. So in a way Le Corbusier stuck with his own interest by using simple geometries, but then neglected his opinion about how design should reflect it's function.

Surface

Le Corbusier kept the surface true to the basic shape of the car, sticking again to his architectural vision. This resulted in a very simple, not technical looking car compared to the other designs. The main differing feature compared to other designs, is that the width of the interior spans across the full width of the car, without extruding mud flaps or running boards which was common in that time. It is really quite two-dimensional, strengthening the hypothesis of a design process working from and building on the floorplan and drawing mostly in plan and side view, as if it were a building. All elements necessary for a car are also neatly integrated, showing their function without taking away from the design. The bumpers for example act as a highlight going around the full body, the spare wheel is visible and accessible, but integrated and flush with the body as are the headlights (Fig. 9). These are all signs of him taking away any form of unnecessary decoration and sticking to his core geometric shape.

The flat panels and simple design could also be a sign of his interpretation of what Ford has done with the model T in 1908. This was fully designed to be mass produced and therefor also kept as simple as possible.

Fig 9. Digital model of the Voiture Minimum by A. A. Lorenzo

Note. Taken from "*Voiture Minimum: Le Corbusier and the Automobile*" (p. 140) by A. A. Lorenzo, 2011, Amsterdam University Press, Amsterdam. Copyright 2011 Amsterdam University Press

Order (regulating line)

Something which Le Corbusier always kept referring to in his architecture is the regulating line and the mathematic calculations behind them. Manuel Franco Taboada, architect and expert in Applying Computer Assisted Design to Architecture, found such a regulating line for the Voiture Minimum as well, after doing a full analysis of the design based on the √2 modulation (Fig. 10). This was at that time the most common proportion used for design.

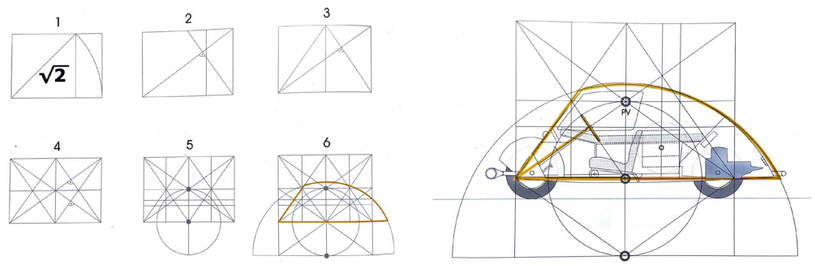

Fig 10. √2 modulation analysis on section of Voiture Minimum by Manuel Franco Taboada.

Note. Taken from "*Voiture Minimum: Le Corbusier and the Automobile*" (p. 234, 235) by A. A. Lorenzo, 2011, Amsterdam University Press, Amsterdam. Copyright 2011 Amsterdam University

Starting with a geometric centre located on the theoretical point of the eyes of the driver, the steering angle, the roof curve, and the windshield angle all follow this set modulation (seen in fig x). Looking closely into the sketches of Le Corbusier, elements of this can also be seen on there. On drawing 22991 (Fig. 11), Le Corbusier defined three points and called them a,b and c. These all fit (closely) to this modulation. Also on drawing 22971 (Fig. 12) a centric point can be seen, which appears to be the centre of the arc that the roof makes (A. A. Lorenzo, 2011). Le Corbusier never mentioned it specifically, but these all point with a relatively high certainty to a design based on mathematical calculation and modulation.

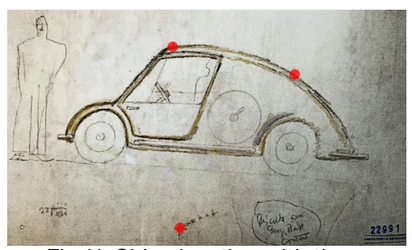

Fig 11. Side elevation with three highlighted points by Le Corbusier

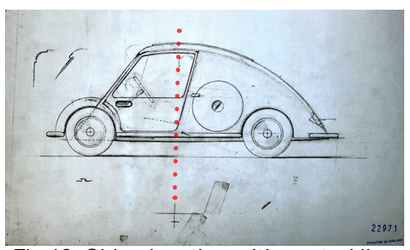

Fig 12. Side elevation with central line by Le Corbusier

Note. Both taken from "*Voiture Minimum: Le Corbusier and the Automobile*" (p. 194, 208) by A. A. Lorenzo, 2011, Amsterdam University Press, Amsterdam. Copyright 2011 Amsterdam University

References

An additional similarity between his architectural background can be seen in the way he approached the design process. Due to their interest in technological advancement and lack of prior knowledge in the field of automotive engineering, Le Corbusier and his cousin approached the design of a vehicle as they would any other architectural project. Instead of starting from zero, they developed a specific proposal using a vast library of references and existing ideas, but making it their own. As mentioned before, the design was handed in too late, before which the SIA organization sent previous entered designs to them, to create an understanding of what generally was expected (Fig. 8). Basic shapes and massing are really quite comparable. The main difference is the bigger focus on aerodynamics for the other designs compared to the Voiture minimum, but in overall volume they are quite similar. Most likely, Le Corbusier took inspiration from existing designs, in order to create his own proposal.

Superficial

His superficial approach to the design is another example of how it compares to his architectural vision. The chassis' structure and workings are of less importance to the bodywork's mass and lines. He explained in a letter to SIA dated April 2, 1936, that they want to leave further technical developing of the design to the experts. He claimed that their primary goal was to design for comfort while driving, as he found this lacking in other car designs. He argues that their defined maximum comfort resulted in the minimum size for any car. Increasing the size of the chassis or bodywork beyond this point is useless to him. Therefore, he argued that it is preferable to refer to his creation as "an automobile" since this will then define the core of all future car designs. Pure and simple, which is similar to how he envisioned his architectural creations. (A. A. Lorenzo, 2011, p. 257 & 258).

As this chapter has explored, there are quite some similarities between Le Corbusier as an architect and Le Corbusier as an automotive designer. The way he approached his design with learning from references and working from the floorplan upwards come from his architectural background. On top of that does the overall shape and appearance of the Voiture Minimum reflect his architectural vision remarkably well. However, in order to fully understand how much these similarities are strictly related to Le Corbusier, in the next chapter it will shortly be compared to other well known car designs from this period.

H4: COMPARISON TO SIMILAR CARS

To understand how much of the found characteristics are uniquely connected to Le Corbusier, the Voiture Minimum can be compared to two other well known automotive designs; The Beetle and the 2CV. These cars were chosen as they are often seen as quite similar because of their purpose of being cheap every-day cars. They are also all from the same period. There has been discussion about the origin date of the design, as Le Corbusier retrospectively argued that his design stemmed from 1926. However, A. A. Lorenzo has researched all his sketches and has showed that this is highly unlikely and that the design originated in 1936 (2011). This is the source this paper assumes is true. For the comparison the same structure will be used as before, but with a less detailed analysis.

The way these automotive designs came to be was quite different, but they were all designed to be a cheap, every day car which was comfortable and usable for every normal citizen. The 2CV has been finalized slightly later due to WW2, but they all are from a similar era, so it is quite easy to explain the similarities in overall shape and proportions.

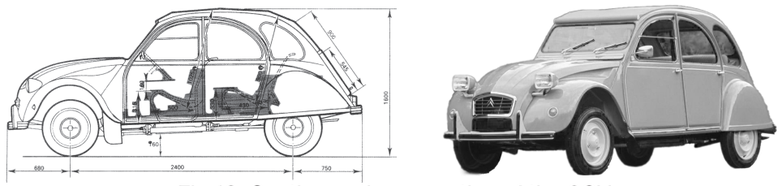

Fig 13. Section and perspective of the 2CV

Note. Taken from *Alles wat je moet weten over de Citroën 2CV* by R. Baeten, 2018, (https://topgear.nl/autonieuws/alles-wat-je-moet-weten-over-de-citroen-2cv/). Copyright 2018, TopGear

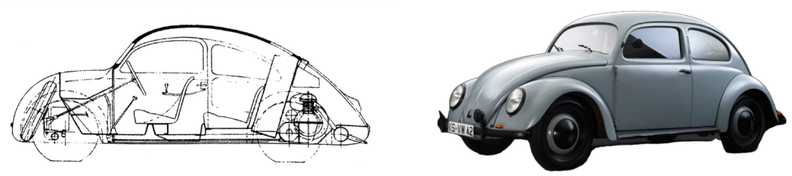

Fig 14. Section and perspective of the Beetle

Note. Taken from *The "Original Beetle" at fahr(T)raum Mattsee* by Fahrtraum, 2020, (https://www.fahrtraum.at/en/the-original-beetle-at-fahrtraum). Copyright 2020, Fahrtraum

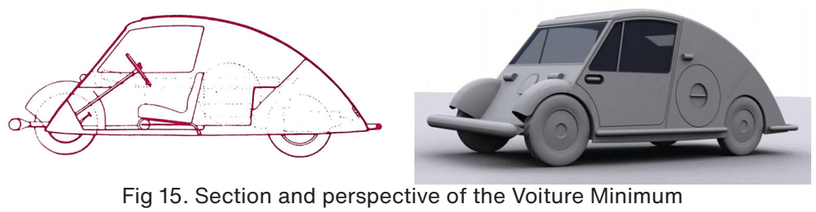

Fig 15. Section and perspective of the Voiture Minimum

Note. Taken from "*Voiture Minimum: Le Corbusier and the Automobile*" (p. 140, 300) by A. A. Lorenzo, 2011, Amsterdam University Press, Amsterdam. Copyright 2011, Amsterdam University

Where differences can be seen is in the way the floorplans are designed. Where Le Corbusier took a whole new path for the seat arrangement with a three person bench in front, which could be used as a bed, with an integrated luggage space behind, the two others are way more conventional. They both have a 2 plus 2 seat arrangement with dedicated storage compartments. The beetle in it's nose and the 2CV at the back, both separated from the main cabin making it more conventional compared to the more living space design in the Voiture Minimum.

For the mass, the overall shape is somewhat similar, but the two other cars have way more emphasis on the back, ironically fitting to Le Corbusier his conceptual shape for luxury car designs. Both of them have a more conventional front, housing the steering arrangement and storage/engine respectively. This one of the most striking differences to the Voiture Minimum, as there it all had been integrated into the design. It looks like a way more simplified two dimensional design.

For the surface treatment, there are some similarities which can be seen between the Voiture Minimum and the 2CV. For both the body is made of thin sheets of material with straight and angular connections. Apart from the mudguards and the main roofline, there are not many curves to be seen. This is in stark contrast to the Beetle, which is a way more sculpted and organic mass fitting to the more aerodynamic focussed approach. However, where the Voiture Minimum sticks to it's two dimensional and integrated design without 'addons', the 2CV is quite a bit more complex with all sorts of creases in the bonnet and the headlights sticking out. The simple surface treatment is similar to that of the Voiture Minimum, but the similarities don't go much deeper than that.

So at first sight, comparisons can be made about the overall shape in section view, so it is hard to say that no inspiration could have been taken between the designs. However, after further analysis, it becomes clear that the Voiture Minimum has little in comparisons with the with the two. The innovative use of space with the seat arrangement and the integration of all elements resulted in a refreshing design. However, Le Corbusier gave himself also more freedom than any other designer would be allowed by not going into technical detail. Rigidity and safety was not taken into consideration for example, placing the passengers right at the front of the car without any form of protection. So the shortcuts that have been taken, and the conceptual design decisions being made by Le Corbusier have led to a refreshing proposal, but it has never made it to production.

CONCLUSION

For a quick recap, the intention of this research was to answer the following question:

“How much did Le Corbusier stay true to his architectural vision and interest for his automotive/industrial design; The Voiture Minimum?”

To be able to create an understanding of this influence, a deep dive into his life as an architect has been made. This was followed up with an analysis and comprehension of his architectural vision. With this summarized and framed understanding of Le Corbusier, a comparison has been made by doing a thorough analysis of the Voiture Minimum. Finally, these results were compared to two well-known automobile designs from the same era that were designed with similar intentions. This has been done to create an understanding of how his architectural vision impacted his design, compared to common automotive design characteristics.

From analysing his personal life and his interests, it can be concluded that he did not just design a car because he had to. It was all coming from a great passion he had for contemporary automotive design and the industrial engineering behind it. This industrial era of design has also translated into his ‘rules’ for modern architecture;

- The plan is the generator of any design concept, rhythm and coherence.
- The mass should be made up of the primary forms.
- The surface must reflect the mass and its function.
- A regulating line has to be used to achieve order, proportion and harmony.

These rules are all almost fully applicable to his automotive design. From the sketches, it can be seen that he focused greatly on the plan of the car. It determined the shape and size. Secondly, for the mass, he used simple, primary forms instead of overcomplicated organic shapes which were the norm. On top of that, all functions are fully integrated, resulting in a surface which is true to its core shape. In the end, a study done by Manuel Franco Taboada, architect and expert in Applying Computer Assisted Design to Architecture, showed that the then conventional $\sqrt{2}$ modulation is applicable for the Voiture Minimum as well.

The similarities that have been highlighted by this analysis and comparison lead to the conclusion that Le Corbusier’s architectural vision and knowledge directly influenced and guided his automotive design. His own set of architectural rules can be directly applied to the Voiture Minimum, aside from the obvious differences between houses and cars.

For this research, there are some shortcomings that should be highlighted. First of all, this analysis has been done to find similarities, so there is a form of bias in the way the research has been done. Secondly, it is hardly surprising that similarities have been found, as both designs have been made by the same person. In the end, it was also not the intention to find hard evidence with this research, as that is impossible with the known literature. However, based on the ease with which direct similarities can be found, it can be concluded that Le Corbusier took great inspiration from his architectural way of thinking.

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