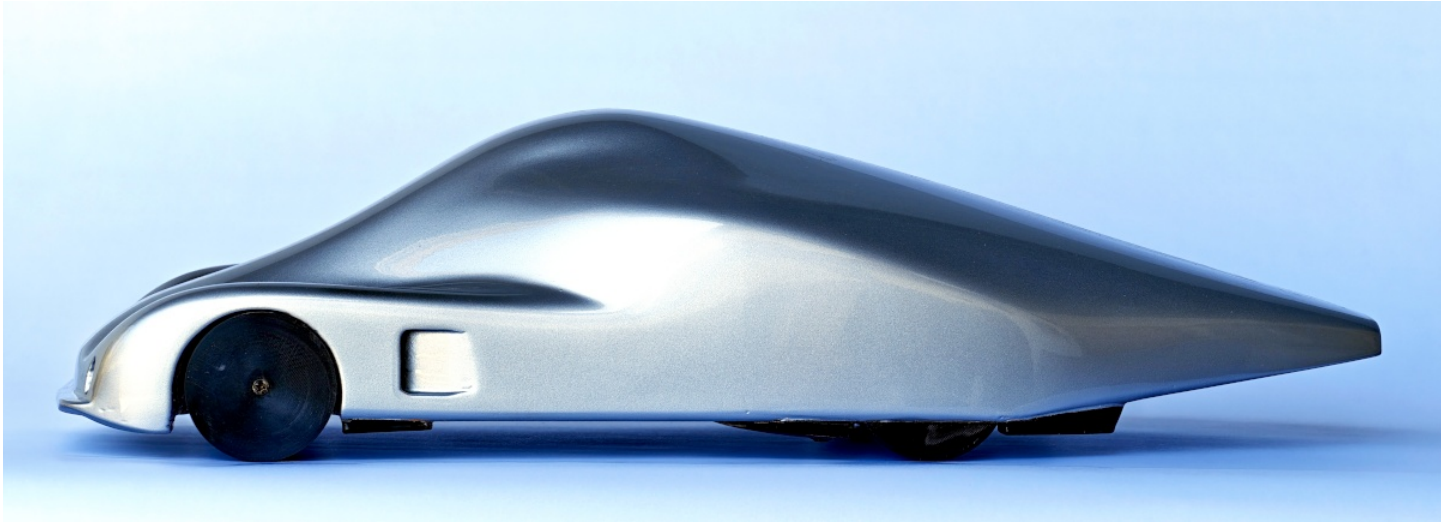


A new generation of automobiles



The inspiration for this patent came from my own experience with single-seater racing (MEP brand in 1966). What a great road handling, what a great dynamical and aerodynamical efficiency!

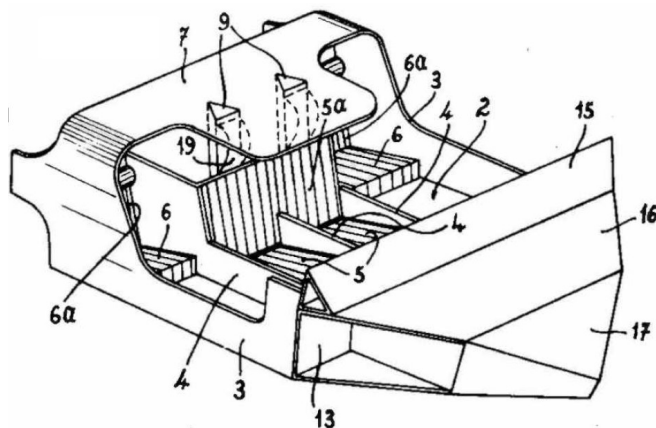
Hence the idea of transposing these intrinsic qualities from a single-seater car to road cars. This leaflet illustrates examples of 2, 3, or 4-seater cars based on an innovative structure bringing benefits on economical, ecological and safety levels.

Jean CELLE



PATENT No FR 2009742 24/09/2020 Publication No FR3114273 .. 25/03/2022
EUROPEAN PATENT No 21806787.4 4182183

The 2020 patent was following another one in 1967, whereby a 4-seater GT car was based on a structure equivalent to 4 single-seater cockpits put together on a same horizontal plane, but staggered on the longitudinal and lateral planes. That first patent inspired Bertone for the NSU Bertone Trapeze, a 2+2 prototype with a rear-central rotative engine.



Patent No 1.523.328 from 13 March 1967
very innovative at the time.

Nuccio Bertone confirming he received the patent :



bertone

CARROZZERIA BERTONE S. A. S. - CORSO CANONICO ALLAMANO, 201 - TELEFONO 783.222 - GRUGLIASCO - CASELLA POSTALE 218/FERR. - TELEGR. BERTONECAR - TORINO

servizio commerciale

Egr. Sig.
Jean Celle
11, Rue Boissac
69 - LYON - 2me
Francia

Grugliasco, 13 aprile 1967

Oggetto : brevetto struttura automobilistica

Ci riferiamo alla Sua cortese lettera del 10 corrente per segnalarLe che abbiamo esaminato il brevetto da Lei gentilmente comunicatoci.

Si tratta di una applicazione quanto mai complessa che può essere determinata solo da un telaio appositamente costruito e quindi riguardante soprattutto le Case costruttrici più che un carrozziere.

Comunque La ringraziamo per la Sua segnalazione e non mancheremo di tenerLa al corrente qualora trovassimo qualche argomento di un certo interesse per la nostra azienda.

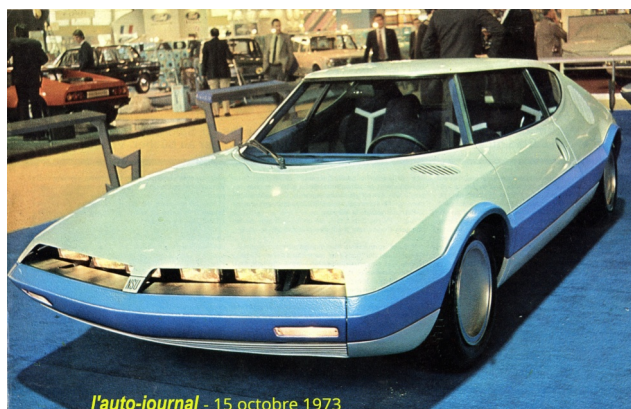
Con l'occasione voglia gradire i ns. migliori saluti.

Carrozzeria BERTONE s.a.s.
N. Bertone

EP/gl
SC/1199

1973: Paris car show

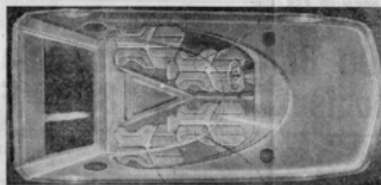
Bertone presents the "Trapeze"



l'auto-journal - 15 octobre 1973



4 places en quinconce sur ce prototype Bertone



On pourra le voir au Salon de Paris, sur le stand Bertone. C'est un prototype unique réalisé par le célèbre carrossier italien, qui a cherché à résoudre le difficile problème de l'habitabilité pour quatre per-

sonnes dans une voiture à moteur central. La solution est originale avec quatre places en quinconce. Comme on peut le voir sur nos photos, la visibilité

semble parfaite avec une surface vitrée très importante, on ne retire aucun angle mort. Quant au groupe propulseur, il s'agit de celui de la NSU RO 80 qui est monté en position centrale.

Bertone innove pour le Salon 2001/1973
Au Salon de l'Auto, qui ouvrira ses portes jeudi, vous pourrez voir une intéressante étude de Bertone pour une 4 places à moteur central.

« T R A P E Z E »

meccanica NSU RO 80

Dossier de Presse - Salon de l'Auto - Paris 1973

BERTONE

Grugliasco, October 1973

Public Relations Department

Press Release no. 7/73

Alongside production models at the Paris Motorshow, Bertone will also be presenting a unique prototype which goes by the name of «TRAPEZE». (x) and uses the engine of the AUDI-NSU RO 80.

This vehicle is an attempt by Bertone at examining in greater detail the very difficult but interesting problem of passenger space in vehicles with a central engine.

Given the unquestionable superiority of the features of Gran Turismo vehicles with a central engine as compared with traditional solutions, it only remains to reconcile these features with general comfort.

Excellent results have been obtained with crosswise positioning of the engine to give two seats (for example, the Miura on which this solution was adopted as far back as 1966).

The problem becomes more difficult, however, if you want to position the engine lengthwise (for optimum distribution of weight) and, at the same time, seat four passengers.

The «TRAPEZE» is an attempt at solving this problem. It is an experiment to find a new solution of accommodating passengers inside the vehicle. The arrangement adopted has considerable advantages over the traditional one. The disaligned position of the rear passenger with respect to the one in front provides him an excellent view. Also, the two front seats which are very closed together allows the rear passenger to stretch his legs out in the wide gap between the front seat and the side door, thus guaranteeing the comfort of all four passengers.

This solution also allows the rear passengers to get out of the vehicle easier.

The wide gap between the front seat and the side door also acts as a safeguard in the case of collisions on the side, thus increasing the safety of the passengers.

On the «TRAPEZE», Bertone has also been able to try out a few purely aesthetic solutions with regard to protection on the side. The functional aspect of this problem is being tackled by the technical people. We believe that the rigorous specification put forward by the American DOT on safety, after the inevitable deadlock period which we are probably still going through, constitutes an excellent "challenge" to the designer to solve the numerous problems put forward from the aesthetic point of view which, although meeting the undeniable demands of safety, have effected considerably the public at large.

Concrete dependable research into these problems is economically demanding and only within the possibilities of large-scale manufacturers and research centres.

Bertone has tried to look beyond the immediate future logically and practically even it means not confronting the problem as a whole which will be possible when the contrasting problems with regard to safety are solved.

DIMENSIONS

- Length	4080 mm.
- Width	1830 mm.
- Height	1100 mm.
- Wheel Base	2430 mm.
- Front track	1390 mm.
- Rear track	1530 mm.

Carrozzeria Bertone S.p.A.
Servizio Pubbliche Relazioni

(x) The name of the vehicle is derived from the special arrangement of the passengers inside.

This automotive structure patent was too innovative at the time!

Cars' architecture is still very much based on the horse carriage model... Here a 2-axle carriage, pulled by two horses, prefacing in medieval style the cars of centuries to come:

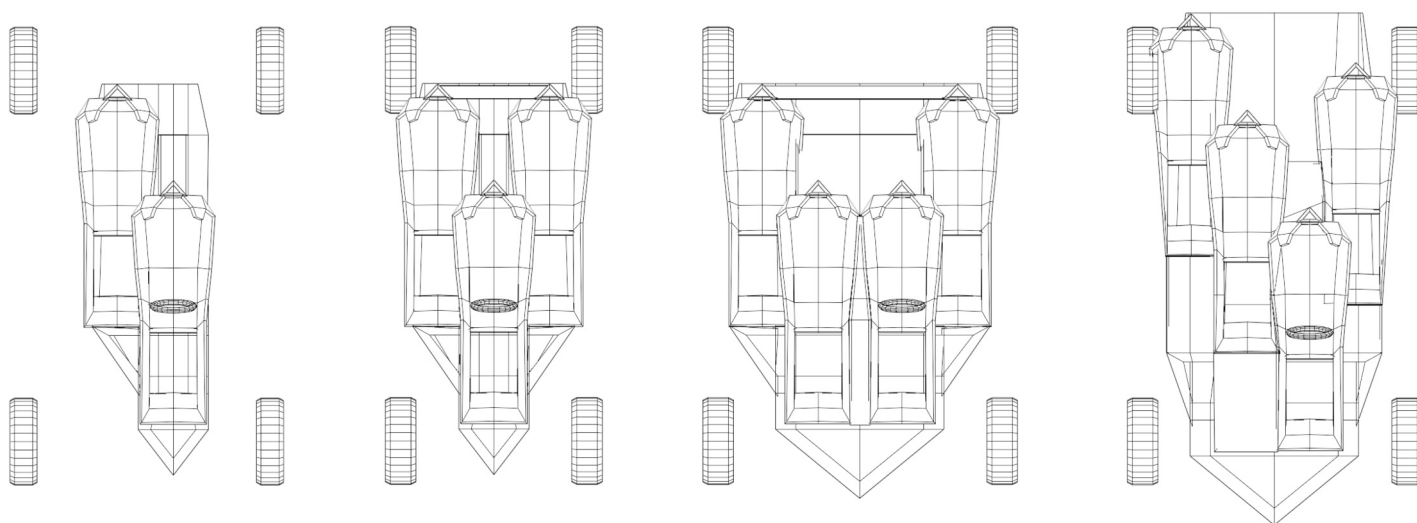


VW ID.3's structure: in the UK, they call that a "Saloon car". We can clearly see how it descends from carriages! The back position is quite vertical, the legs are cramped, even more so at the rear. Moreover the rear passengers have the front passengers' headrests in front of them instead of seeing the road, which can increase motion sickness!

2020: for the past few years I have been thinking that the fact of having the seats staggered not only on 2 dimensional planes (longitudinal and lateral, as per the 1967 patent) but on 3 dimensional planes, by also making use of the height factor, would allow to reduce the width of a 3 or 4-seater structure even further, by laterally interlocking the seats, of Formula 1 type -as can be found in the RP1 sports car from Elemental Cars-. In the patent's implementation, the raised position of the driver central structure allows the driver to have their eyes at an appropriate height to allow for proper visibility towards the front on roads with declivities. Too low a driving position would prove dangerous on that aspect. You have marshals watching for dangers on motor racing tracks, but not on roads!



Elemental Cars' Spider RP1- See : <https://elementalcars.co.uk/the-rp1/design-2/>



The patent offers a revolutionary approach, by creating a space without any seats fitted in the cabin. Instead, the structures in the car's central chassis act as seat spaces, a benefit both in terms of weight and rigidity. Seat upholstery is fitted in each passenger's space.

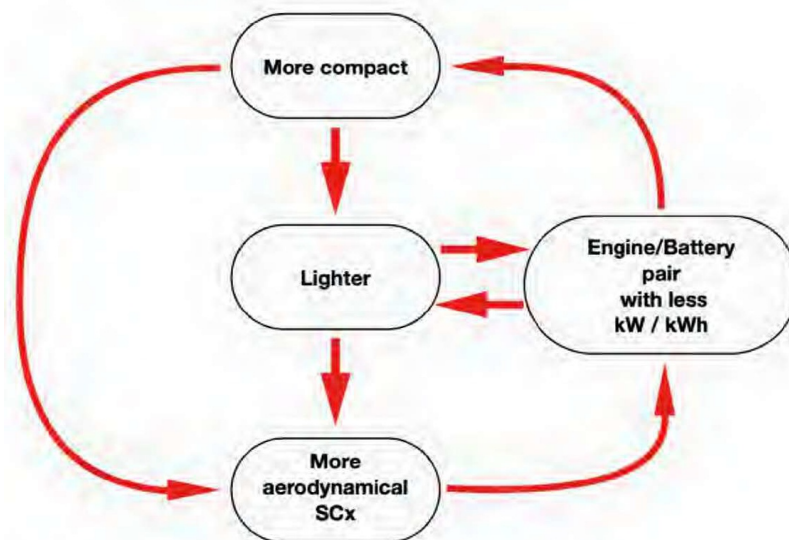
Benefits of a structure of seats slotted on 3 dimensional planes for 2, 3 or 4-seater cars

For each version of this patent, be it 2, 3 or 4-seater, the seat structures, slotted, constitute the car's central structure frame. Around this frame, all the car's parts, such as suspensions, wheels, engine (if not in the wheels), the electric engine command modules, and a luggage space are then added. The skin that wraps around all of these interior parts determines a car body that has optimum aerodynamics, with the kingfisher shape as a model.

Possible feature for the three options: fitting electric engines in the wheels, like on the 3-wheeled Aptera. The one engine per wheel concept is biomimicry from animals that have great acceleration muscle ability in their four legs. As for the kangaroo, his power is focused in his oversized rear legs compared to the front legs, like rear-wheel drive cars.

Apparently, the inconvenient of placing an engine in a wheel is the increase of the unsprung mass, which may slightly impact the wheel kinetics on irregular road surfaces. But this is compensated by the use of a 4-wheel drive system, allowing for smaller diameter and lighter wheels, and by the absence of a transmission axle (which would otherwise increase the unsprung mass in the power wheels).

Virtuous circle in terms of economy and ecology: as an example, for an electric car, in comparison to the models currently sold, we have here a more compact structure, allowing for a more aerodynamical, more rigid, and lighter car body, which leads to a lower need of power for the same performance. This allows to fit a battery pack of lower capacity, lighter and smaller in size, as well as a less powerful electric engine, which is in turn lighter and smaller in size... This is a virtuous circle dynamic, which results in an optimum structure and shape, similar to what occurs in living beings after a long evolution, leading to the best energetic yield possible.



Benefits during manufacturing process

This invention allows for a lower need in material, energy and workforce for the manufacturing of this type of automotive structure. It therefore allows to significantly reduce its manufacturing cost as well as the retail price in order to make the vehicles produced affordable to a greater number of motorists, rental or carpooling companies. Less material for the smaller and lighter structure: less extraction of minerals and rare earths, this is a benefit both from an ecological and social perspective.

Benefits in use

Active/Passive safety

The weights distribution, predominantly at the centre of the vehicle, contributes to a very safe road handling.

Batteries positioning in the car's central third section, instead of nearly the full width, strongly reduces the moment of inertia along the car's longitudinal axis. This is also an added improvement in the safe ability to handle sudden swerves (moose test).

The "kingfisher" car body shape, very suited to this structure, positions the centre of pressure behind the centre of gravity and the centre of adhesion, giving the car a great stability in regard to lateral winds.

This type of car, very aerodynamical, requires less power for the same speed, which translates into less engine noise and less aerodynamics noise: double benefit for a more silent cabin.

The front structure's V shape provides a great ability of semi-frontal shock absorption and of obstacles avoidance.

The sides are quite tall, as in a one-seater car cockpit, so as to make the whole block of seats structures very solid. This allows to avoid the use of thick windscreen pillars to protect the cabin as seen on classic cars which cabin have a parallelepipedic volume, fragile by nature, with the doors opening just next to the seats and down to car floor level, and therefore require big pillars for proper resistance to shocks.

The driver's visibility field, over 180 degrees, is achievable thanks to the forward position of the driver and the possibility of very thin windscreen pillars. This allows for improved active safety in comparison to current cars which voluminous windscreen pillars obstruct part of the visual field, causing a potential risk of accident.

The wrapping structure of passengers' spaces, with back rest pillars that are holding the roof, is a distinctive advantage in comparison to current cars. The seat structures, bonded with the whole car structure, can be used to support a reinforced roof, equivalent to the halo of Formula 1 cars, for each occupant, in order to provide an optimal protection at head level.

The central position of the driver in the 3-seater version or of the front occupants in the 4-seater version increases their protection in case of lateral or partially frontal shock. Considering the high number of single - or frequently double - occupancy vehicles in most journeys, this means a decreased risk of serious or fatal injury in the event of an accident.

The battery capacity requirements being reduced, the battery can then fit in the structure's centre, under the driver, and between rear passengers. As a result, the absence of battery on the car's sides increases passive safety in case of a lateral collision.

Purchase and usage cost

The lower purchase cost in comparison to conventional vehicles of a similar capacity is intrinsically related to this structure shape which allows for a reduced use of material, the installation of a smaller capacity - but with greater driving range - battery, and the use of an engine of a lower power but which provides better performance thanks to the reduced car weight and the very low SCx. All this results in the reduction of both manufacturing cost and retail price.

The lower running cost induces low amortisation thanks to the reduced purchase cost, combined with the low energy consumption of vehicles based on this type of structure.

The decreased energy consumption (about 2 times less kWh on dual-carriage ways and motorways), allows as well to stop less frequently and for a shorter recharge. This higher rotation of low-consumption cars users contributes to a reduced need in electric charging points compared to an automotive pool that needs 2 times more energy, and that takes 2 times longer to recharge. This is a gain of time for users and also, at a macro-economical level, a significantly lower need of charging stations and electricity production.

A lighter car, thanks to this type of structure, is an advantage for less tyre wear (cost for the user) and for less roads surface wear (cost for collectivity, see AASHO study (1)). Current electric cars, heavier than their thermal equivalents, due to the weight of high-capacity batteries, have their tyres wear faster. This tyre wear has a double economical and ecological cost: increased tyre production and spread of micro and nano rubber particles, together with an increase in atmospheric pollution and in pathologies related to this increased chemical pollution (2)

(1) The AASHO road test introduced many concepts in pavement engineering, including the load equivalency factor. Unsurprisingly, the heavier vehicles reduced the serviceability in a much shorter time than light vehicles, and the oft-quoted figure, called the generalized fourth power law,[2] that damage caused by vehicles is "related to the 4th power of their axle weight", is derived from this.

Source: https://en.wikipedia.org/wiki/MSHO_Road_Test

(2) **each tyre wears by releasing rubber and synthetic polymers residue**, which penetrates soils, rivers and air. The higher the replacement frequency, the higher the accumulated emissions. A study from British organisation Emissions Analytics deemed that in 2022 that **the tyre particle emissions can be higher than exhaust gas emissions on some modern vehicles**.

Source: https://actu.caminteresse.fr/sciences/pourquoi-les-pneus-dune-voiture-electrique-susent-ils-plus-vite-11203205/?utm_source=welcomingautoactus&utm_medium=cpc&utm_campaign=pmo_cam_article

Propositions for manufacturing

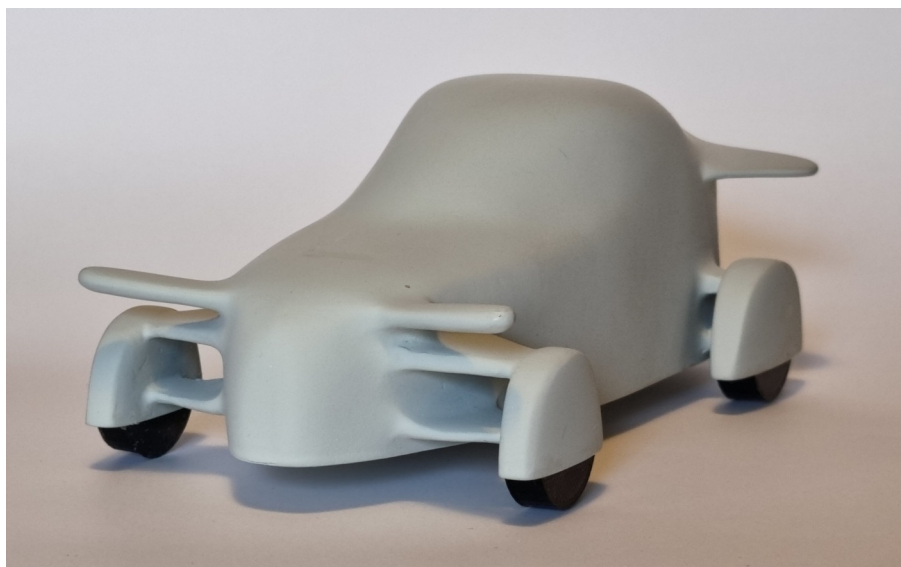
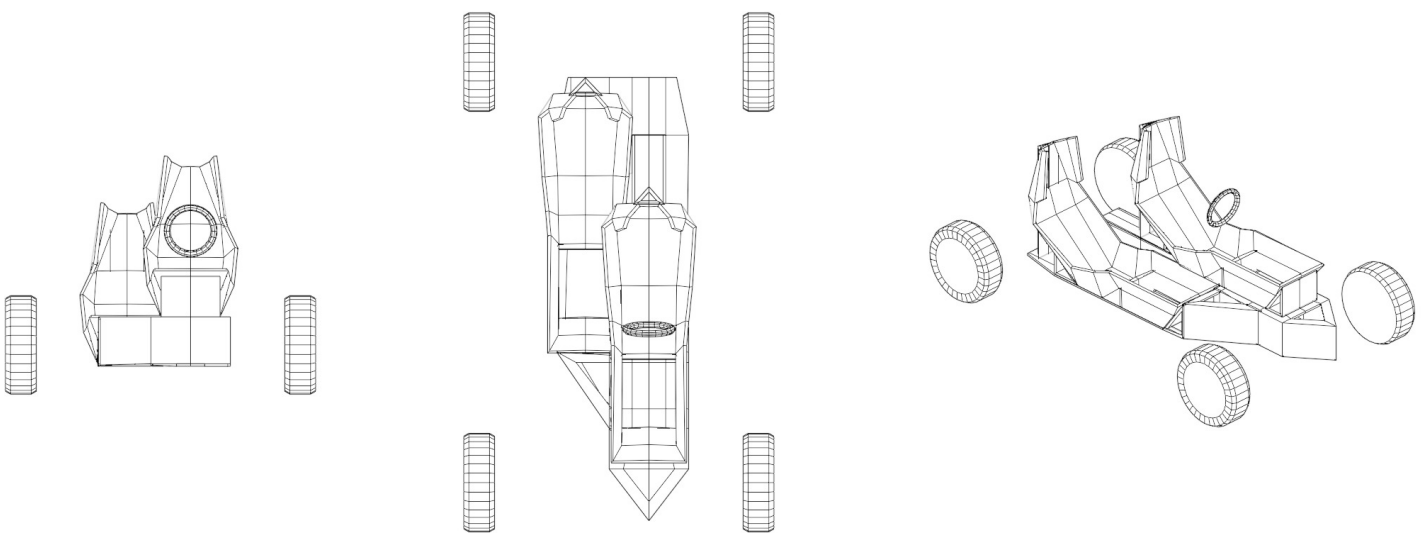
2 seater version: the body, of an elongated oval shape, is quite narrow, the wheels are outside the car body (as in a single-seater) and are housed in wheel fairings for better air flow.

This layout is also particularly adapted to offer directional rear-wheels, like the rear legs of quadruped animals, for a better agility/road handling.

Due to the narrow width of the front and rear area, the principle of the hammerhead shark fins is replicated, in order to fit the road and indicator lights on the sides of the car and at the appropriate height. Depending on the car's main usage (city/suburban or road/motorway) these fins will have a varying surface, fixed or adjustable in order to modulate the lift coefficient C_z (downforce) at the level of each wheel. In Formula 1 cars, a big rear spoiler providing high downforce in order to maximise traction in bends and curves can be set flat in straight line in order to reduce the C_x (feature known as "DRS"), increase speed and make overtaking easier. Conversely, for a road car, the adjustable spoilers can be set in a minimal C_x position in straight line to reduce energy consumption (and not to increase speed). When necessary, automatically setting 1, 2, 3 or 4 spoilers down increases downforce C_z and improves instantly grip/road handling, while C_x and energy consumption temporarily increases. In "Eco" mode, the spoilers control system would not be activated in bends, except by the electronic stability program ESP, and energy consumption will be minimal.

This could be the 21st century's Lotus Super Seven, a quantum technological leap, thanks to a dynamic handling in the single-seater style, with the mass distribution concentrated on the centre axis...

The 2-seater version can also be produced in a simplified version, in the frame of the heavy quadricycle L7e category, with a total weight of 450kg. Its compact and light structure, allowing a very aerodynamical shape, combined with great lightness, would be a significant leap in quality compared to current models.

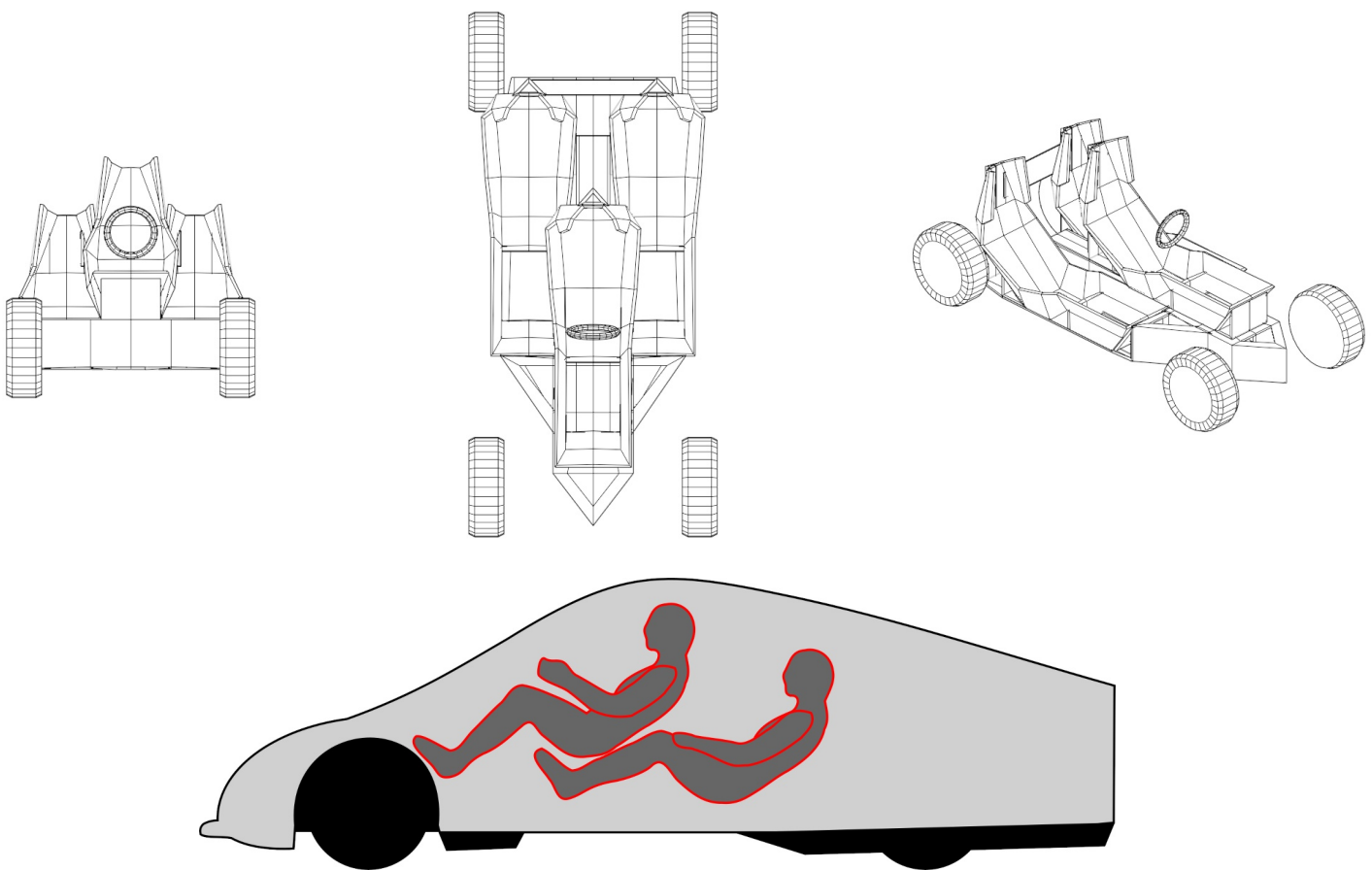


3-seater, short version: Thanks to the partial slotting of rear seats structures under the driver's cockpit, the total body shell width is shorter to that of an average conventional saloon car. Moreover the forward placement of the driver's cockpit allows for an exterior body shape that is very faithful to the kingfisher shape for optimum aerodynamics.

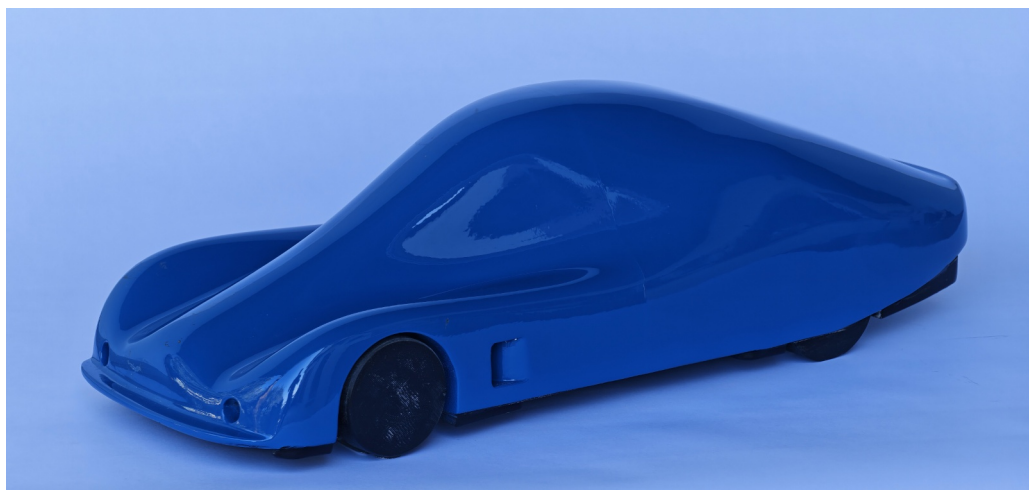
The 3-seater version provides maximal forward and lateral visibility to the driver (thanks to the central and forward position), providing an ideal viewpoint to place the car on the road, like in a one-seater, as opposed to the very eccentric lateral position on conventional cars. It is more biomimetic to have the eyes in the median axis of the human/car body. This ideal central position is currently found only on "supercars" such as the McLaren GT F1, Gordon Murray T.50 and S1, as well as the Lotus Theory 1 concept car, which are million Euro cars, while the patent allows to bring this unique advantage to popular and affordable cars.

This "GT" version can be made in a form that is even more compact, lighter, more economical to manufacture and to use, under a 1+2 format, with lateral seats slightly reduced in size and more slotted under the driver seat, in order to reach even better Cx and SCx figures.

It can be made in short version (L 4.46m I 1.66m H 1.33m Cx 0.196 SCx 0.326, see below) or in long version for a reduced Cx (see next page).



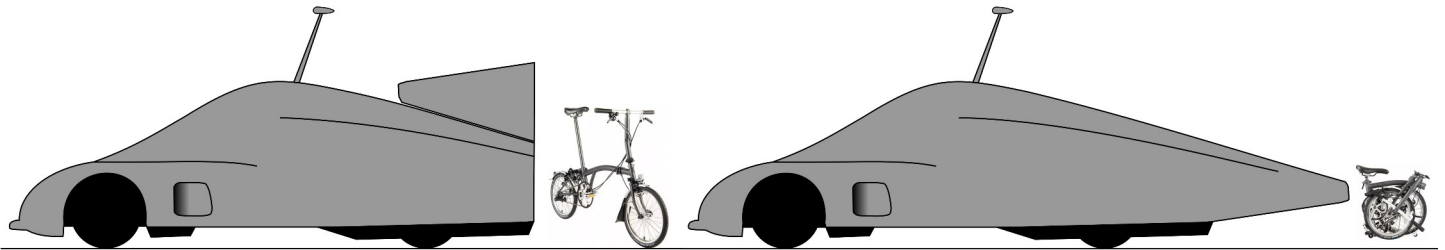
Optimum comfort and great visibility towards the front of the road for the rear passengers



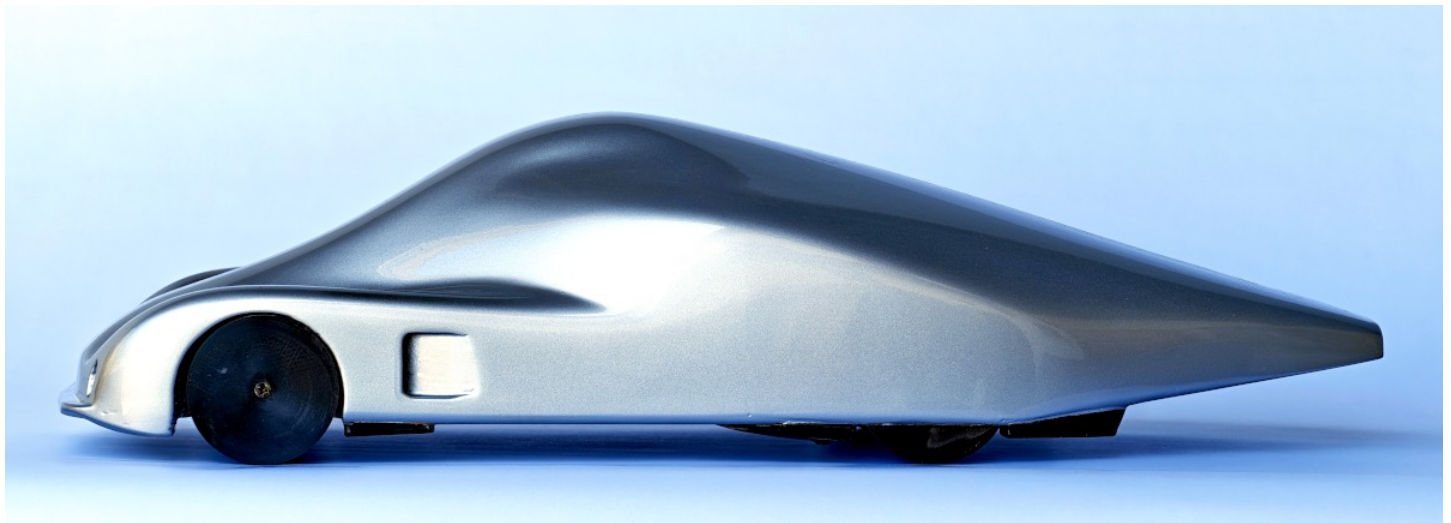
3-seater, long version, with variable geometry. A 3-seater GT stretched to 5.15m to reduce the rear end to 80 cm in width and 15 cm in height, by adding a 1-meter long trunk to the 4.15m of the base model. This trunk can host a folding Brompton electric bicycle and its accessories. This allows the driver to continue his city trip by bicycle (in 80% of cases, only one person per car, as per observations on road trips). When arriving in urban areas, this extra trunk can fully fold over the main trunk, alike a roof rack, so that the car becomes shorter and makes parking easier.

The maximum height of the GT then goes from 1.35m to 1.55m and its length is reduced to 4.15m.

The disadvantage of a greater length (5.15m) with this “aerodynamics” trunk is doubly compensated: transport of a city bicycle and significant improvement of the Cx (0.158 instead of 0.196 in the short version), as well of the SCx (0.258 instead of 0.326 in the short version)!!



The schematics show a periscope rising to 1.90m, aimed at increasing the LiDAR's driving assistance range, and to detect a car that would precede a SUV that one would follow. This system allows the cruise control to better anticipate speed changes in the traffic... The periscope also integrates side mirror cameras and the red braking light. Finally, the top of it features a safety beacon (already compulsory in Spain), way safer than the laying of a warning triangle on the road, which frequently causes secondary accidents! When stationary, the periscope can retract in the driver's seat column.



Urban and suburban 3 seats: Assessment in comparison to the Smart ForTwo #1. Using similar width (1.66m) and height (1.55m), and a length extended from 2.69m to 2.99m (+30cm), this concept

offers 3 seats instead of 2, with a lighter structure and significantly improved aerodynamics. This weight reduction improves particularly the energy consumption during acceleration, and the better aerodynamics also favour better consumption on fast roads.

Another benefit of a lesser energy consumption: less mechanical and aerodynamics noises, which helps for a quieter urban environment.

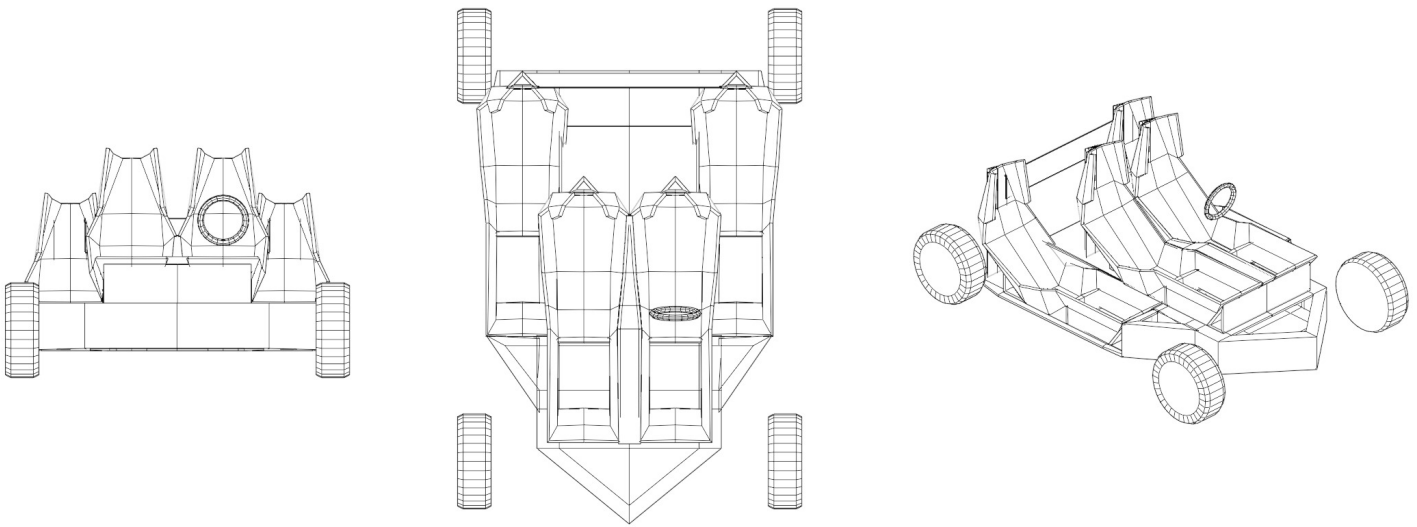
It is as easy for the driver to get in and out of the car by the right or left side, a great benefit in urban areas.

The driver gets great protection from lateral collision thanks to his central position.

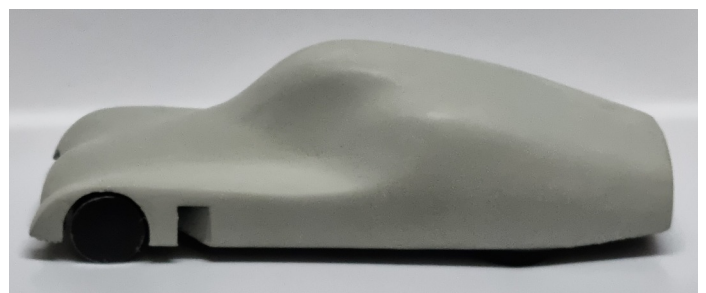
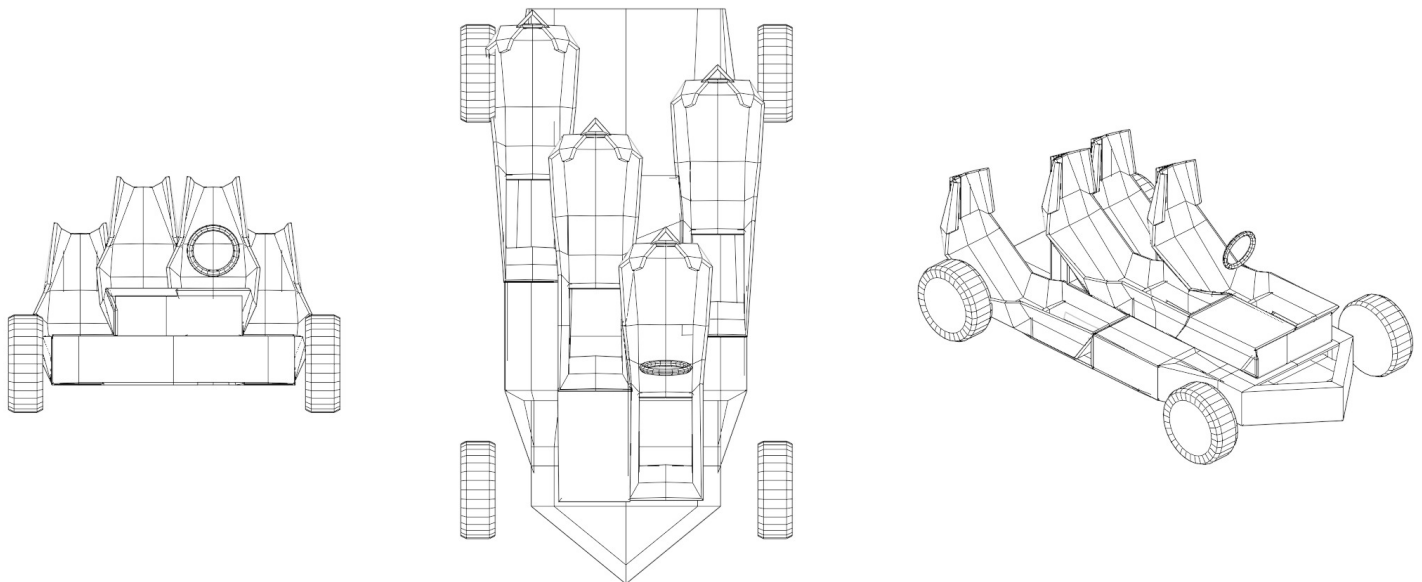


4-seater version: amongst possible versions, 2 propositions.

- **symmetric version**, with a length similar to the 3-seater version and an increased width. Some similarities with the Bertone Trapeze, but with a unibody (instead of tubular) structure, with a stepping in height so as to slightly stagger front and rear spaces, in the aim of giving more space to each occupant.



- **asymmetric version**, with reduced width and greater length in comparison to the symmetric version. It has a further link with biomimicry, with an internal dissymmetry like in the human body. The driver and front passenger spaces are slightly staggered with respect to each other, on longitudinal and lateral planes. This consequently determines the position of rear passengers, with a similar staggered placement. This allows to logically stagger the front and rear wheels of the right side with respect to the left side, while keeping the same wheelbase on the right and left, so as to optimise comfort when driving over speed bumps by spreading the move over the obstacles in four vertical moves instead of two. The car body won't show any visible dissymmetry since the front wheel arches are positioned differently but are not visible simultaneously by an outside observer.





Kingfisher



Shinkansen train, Japan



Bernard Serol



Static test by Jean Celle of the NSU Bertone Trapeze

Examples of aerodynamic performances : Cx and SCx

Modèle	Coefficient Cx	Surface m² S	Résistance SCx	Poids Kg	Batterie kWh
ALPINE A110 thermique 2025	0,32	2,17	0,62	1114	
VW ID.3 58 Kwh 2025	0,267	2,217	0,592	1730	58
TESLA Model 3 2024	0,23	2,17	0,50	1645	60
RENAULT Mégane E-Tech EV60 2025			0,713	1636	60
MERCEDES EQS AWD AMG 53	0,20	2,475	0,495	2655	120
MERCEDES EQXX	0,17	2,12	0,36	1755	100
APTERA 60 Kwh 3 roues 2 places –	0,13	1,86	0,24	800	60
McLaren GTR F1 3 places *	0,32	1,78	0,57		
VW concept Mission Efficiency 2+2	0,158	2,076	0,328	1650	54,9
3 seater version, long body	0,158	1,633	0,258	850 à 880	30 à 40

At cruising speed on dual-carriage ways or motorways, the power (and therefore the energy consumption) required are predominantly proportional to the SCx... and consequently a very low SCx provides a huge advantage in terms of reduction of energy consumption, driving range, low running noise - both aerodynamic and mechanical -.

On a trip at urban speed -30 to 50 km/h- weight is the most contributing factor on energy consumption, related to road contact and acceleration needs, even if subsequently part of the braking energy is stored back. Thanks to a weight divided by two compared to most current electric cars, energy consumption on similar trips (with frequent changes of pace) is also in the ballpark of twice lower.

Therefore energy needs are twice lower both at low speed and highway speed.

A 3-seater car based on this structure, equipped with a 30 kWh battery, would achieve, thanks to its very low SCx and very light weight, the driving range of a current electric car equipped with a 60kWh battery. This was verified with a model test thanks to Mr Bernard SEROL's Eiffel-type wind tunnel.

This model made by myself (neither engineer nor aerodynamicist) and finished by a professional body-maker, applies the biomimicry taken from the kingfisher. The Cx for the long version 2.4 measured at 0.158 and 0.258 SCx can be significantly improved by professional aerodynamicists. This last model is only the third 3-seater variant designed and created at 1:8 scale, which shows the potential for important improvements obtainable with further development of this concept.

This type of 2, 3, 4-seater car could be named "Formula 2", "Formula 3", "Formula 4", as we can consider them as single-seaters interlocked side by side, with an optimised staggered positioning on the 3 dimensions.

Our current world needs, for all the reasons expressed previously, and particularly for economical and ecological reasons, this new generation of very evolved cars, as a complement from current and common car designs, polyvalent or adapted to specific needs but way less energy efficient!

Jean CELLE

jean.celle@gmail.com

<https://www.jc43.fr>

(*) <https://www.motorsdb.com/fiche-technique/auto/141/McLaren-F1-1993-1998.html>