Geneva 2005: innovative technology and increased complex glazing

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The 2005 edition of the Geneva Motor Show saw a great deal of innovations. The introduction of electrochromic sunroofs and complex shaped glazing moved towards increased visibility. The use of carbon fiber composites and transparent steel plates enhanced rigidity, while fuel cell evolution for clean environments and dashboard technology were further highlights of the show.

Fig. 1 - The electrochromic sunroof of the Superamerica Ferrari

ELECTROCHROMIC SUNROOFS

For the first time, an EC (electrochromic) sunroof has been adopted in a car produced by Ferrari, even if for a limited production. In fact, at the presentation of the Ferrari Superamerica in Europe at the Geneva Motor Show 2005, EC glass produced by *Saint-Gobain* was used in combination with an innovative rotating roof movement shown in Figure 1.

The main reason of this design choice, with collaboration between Pininfarina and Fioravanti with Ferrari and Saint-Gobain, is due to the large size of the roof (about 1.4 square metres) with possible discomfort caused by the sun's rays entering the car through the glass roof.

The Saint-Gobain EC glass is certainly an advanced solution of solid electrochromic technology based on five layers, which is claimed to perform without degradation, even with UV, (see paper by St. Giron et alias "Electrochromic automotive sunroof" GPD, Proceedings 15-18 June 2003, pp. 460-461).

The Saint-Gobain EC technology "SGS lightening" is a laminated glazing which incorporates monolithic, all solid state, four sputtered EC coatings: two ITO electrodes films; one EC WO_3 film; one storage ion film; and one laminated plastic electrolyte as a central sandwiched layer.

For the sunroof, the glazing is encapsulated and incorporates reinforcement bars or frames to bring stiffness to the roof. Various types of tinted glass (five for Ferrari) can be used based on the range of visible luminous transmission EC switching in the range of 1-15 per cent.

The Ferrari Superamerica sunroof performs by means of a manual device, changing the total T_E sun energy transmission in the range of $0{,}5 \leq T_E \leq 7\%$ at high speed (60 seconds) for colouring and a little longer for bleaching. The electrochromic state of transmission on colouring (on) has a long memory and, thus, operates as a sun protection even at soak car parking conditions, giving strong solar control performances by means of IR absorption as shown in Figure 3.

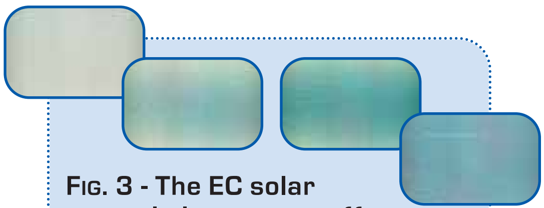

Fig. 3 - The EC solar control glass at on - off state by low voltage

Considerations

The IR cut-off seems efficient but the variation of visible transmission T_V is difficult to be directly appreciated in the range of $5\% \leq T_V \leq 20\%$.

CARBON FIBER PLASTIC COMPOSITES

Plastic epoxies reinforced by carbon fiber,

Fig. 2 - The EC sunroof incorporating reinforcement bars; the frame of the roof is in plastic reinforced by carbon fiber (see bottom of the picture)

Fig. 4 - Volvo concept car CCS with plastic carbon fiber as a frame of sunroof glass

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mainly used for high rigidity frames in vehicles, are now applied more and more in several body components such as in the Ferrari Superamerica (see Figure 2) and Volvo concept car (Figure 4) both for sunroof frames.

Considerations

The difficulties seem confined to the adhesive bonding between the glass and the carbon fiber frame, which has to be approached taking into account the differences of interface regarding surface energies and temperature range dilatation stresses, and mechanical vibrations, all varying with fiber orientation.

SEMI-TRANSPARENT STEEL

Following the Geneva Motor Show 2004 [1], sheet steel with suitable designed pattern holes has been creatively realized by the Italian designer Fioravanti on the innovative Coupe Kite

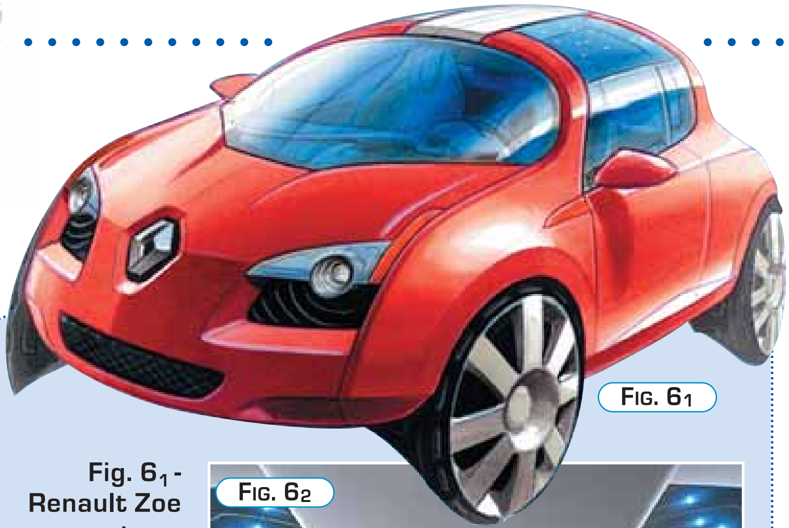

FIG. 6_1

FIG. 6_2

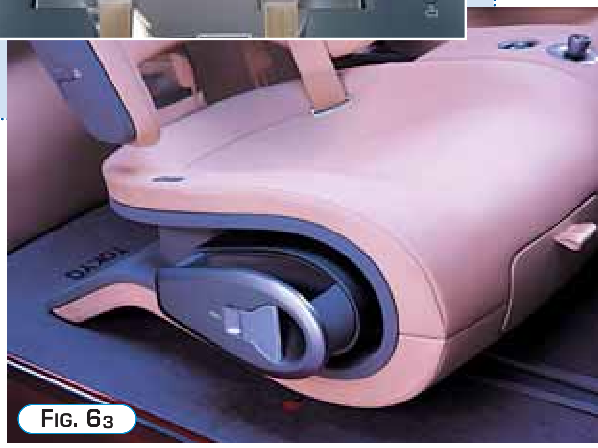

FIG. 6_3

Fig. 6_1 - Renault Zoe concept car

Fig. 6_2 - LED lighting from the transparent part of the roof

Fig. 6_3 - Special cushions designed with a round shape

FIG. 5_1

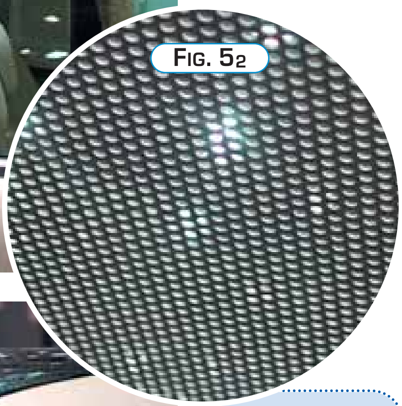

FIG. 5_2

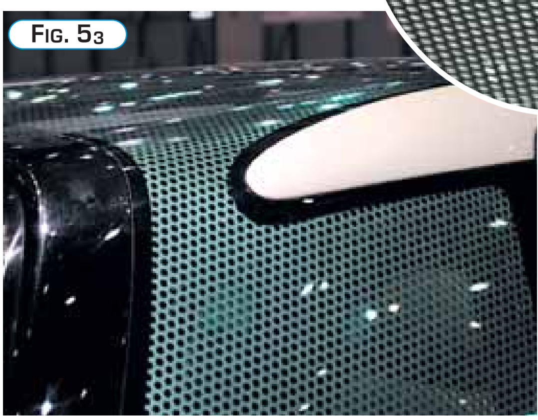

FIG. 5_3

FIGS. 5_1, 5_2 and 5_3 - Semi-transparent side, roof and backlite windows with sheet steel

to obtain semitransparent side (Figure 5_1), roof (Figure 5_2) and backlite windows (Figure 5_3) to increase the rigidity of the car compared with normal glass windows.

NEW PLASTIC CONCEPTS AND LUMINESCENT GLASSES

The Renault Zoé concept car (Figure 6_1) can be considered one of the main creative and innovative cars of the show, especially for its:

- internal compartment. In fact, the relatively wide internal compartment (Figure 6_2) comfortably seats three passengers on special soft down cushions, designed with a circular shape, supported by reinforced plastic structural materials (Figure 6_3);
- LED lighting from the transparent part of sunroof (Figure 6_2);

FIG. 6_4

FIG. 6_5

Figs. 6_4 and 6_5 - The flexible plastic wiring net covering the baggage area

• special hatchback support panel in a flexible plastic wiring net (Figure 6_4) with very low weight and able to avoid personal objects moving about (Figure 6_4) while covering the wide baggage area (Figure 6_5).

DASHBOARD EMOTIONAL TECHNOLOGY

Emotional technology is almost a science[2] based on a semantic software classification of comfort/utility and visibility/esthetical view. In line with this technology [2], [3], some examples have given the feeling that Kansei software is starting to be applied in the following examples on dashboards - windshield - external mirror systems.

Toyota Aygo and the innovative Yaris, where emotional technology design realized the ergonomical ratio of the windshield inclination and special narrow height and shape of the dashboard with its colour - surface morphology (Figure 7_1) matching that of the seat. A still flat (too low back vision) external mirror is part of the visibility system in order to obtain simultaneous optimal vision: forward through the windshield, combined with instrument location and mirror rear angles, all suitably coordinated for driving.

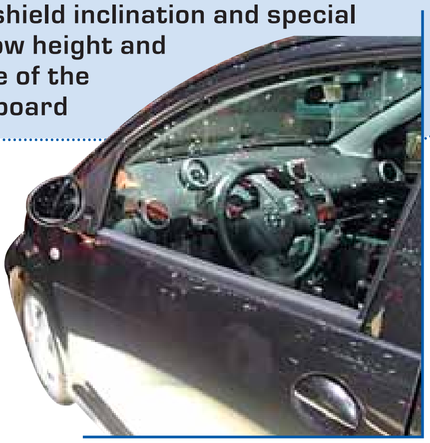

Fig. 7_1- The ergonomical ratio of the windshield inclination and special narrow height and shape of the dashboard

Particular attention has been paid to the black interior trim with its absorbing/reflection on windshield, compared with the exclusive dark grey interior trim with a surface pattern porous morphology, as shown in Figure 7_2. Both the seat trim colour and their pattern morphology are extended to the dashboard surface, which contribute to reduce the scattering/reflection light from the dashboard to the windshield surface. This, in turn, increases the driver's reflection/scattering light ratio as well as that interacting and coming from the external body paint.

Fig. 7_2 - The black and exclusive dark grey interior trim are suitably extended to the dashboard surface to reduce their reflection/ scattering light ratio

Another innovative results of the compactness of the Aygo is the hatchback equipped with a hydraulic bar, moving the whole back bonnet (Figure 7_3), providing suitable panel support for musical instruments.

This can be considered part of the modular evolution of car vehicle assembly, with structural support using a great variety of different body components easy to

Fig. 7_3 - The hydraulic bar moving the whole back bonnet of the Aygo

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Figs. 8_1 and 8_2 - Further examples of Fiat-Lancia designers' approach to ergonomics with the Lancia Ypsilon Sport

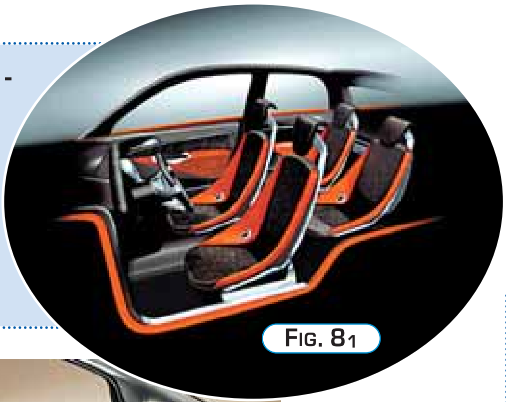

FIG. 8_1

FIG. 8_2

assembly and dismantle for replacement and ELV recycling.

Lancia Ypsilon Sport and other examples of emotional technology

Another example of good ergonomical approach by Fiat-Lancia designers is that of matching the wide internal space with seating flexibility, esthetical and emotional dashboard and lower windshield reflection.

Other outstanding examples are:

- the innovative Renault Marus (Figure 9_1), with a reduced number of instruments on the

Fig. 9_1 - The dashboard of the Renault Marus

Fig. 9_2 - The previous Renault New Laguna

FIG. 9_2

FIG. 9_1

FIG. 10$_1$

FIG. 10$_3$

FIG. 10$_2$

Fig. 10$_1$ The less emotional and visibility level dashboard of Fiat Nuova Croma

Fig. 10$_2$ - The BMW 320 dashboard following Kansei emotional technology

Fig. 10$_3$ - The Mercedes Class B dashboard and its instrument panel

Figs. 11$_1$, 11$_2$ and 11$_3$ The Birdcage with its two original dashboards

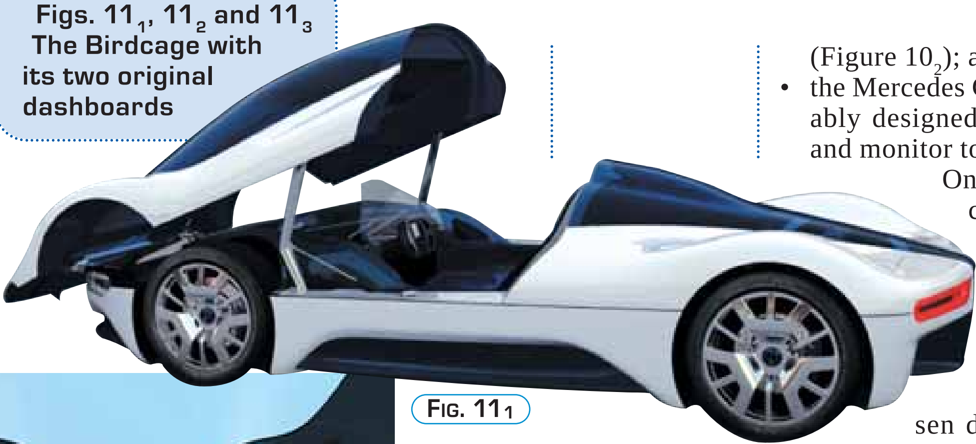

FIG. 11$_1$

FIG. 11$_2$

FIG. 11$_3$

white dashboard, also reducing solar heating in soak conditions. compared to the previous Renault New Laguna (Figure 9$_2$);

- the less emotional and visibility level dashboard of the Fiat Nuova Croma (Figure 10$_1$);
- compared with that of the BMW 320 following Kansei emotional technology even more (Figure 10$_2$); and
- the Mercedes Class B (Figure 10$_3$) less suitably designed with too many instruments and monitor to the right.

One of the real outstanding concepts of emotional technologies is the Birdcage 75, with two original exceptional dashboards by Pininfarina (Figures 11$_{1,2 \text{ and } 3}$). The differences of this concept car can be seen in the two chosen dashboards - really high but both optimal - in addition to emotional, ergonomic, and visibility performance, which seem appropriate with their electronically innovative instruments very well in line with the driver's forward visibility through the windshield.

EXTERNAL MIRRORS

External mirrors are increasing in size in order to improve back angle visibility, as shown in Mercedes (Figure 10$_3$), in Jaguar IPG (Figure 12$_1$) and in concept cars such as the new Opel Astra (Figure 12$_2$), Mazda 6 and Peugeot 107 (Figure 12$_3$). The wide exter-

FIG. 12$_2$

Figs. 12$_1$, 12$_2$ and 12$_3$ - Increasing sizes in external mirrors

FIG. 12$_1$

FIG. 12$_3$

Figs. 13_1 and 13_2 - Total integration of the Nissan Zaroot external mirror

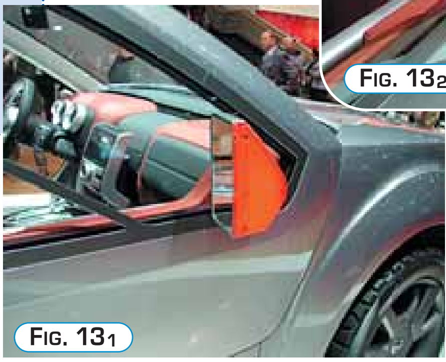

Fig. 13_1

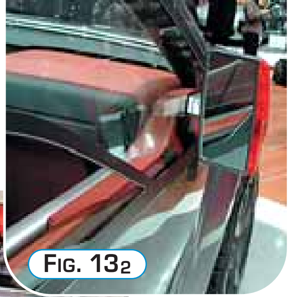

Fig. 13_2

nal mirrors are quite negative with regards to the car's air fluid dyna-mic penetration and the probability of impact,

Fig. 14_1 - Original LED rear illumination in the Fioravanti Kite

Fig. 14_2 - Lexus IS LED front illumination

Fig. 14_3 - The swinging glazing roof of the Renault Zoe with LED illumination

Fig. 14_1

Fig. 14_2

Fig. 14_3

especially in parking and entry in small modern garages.

This can be seen even more enchanced in the case of the very special external mirror for the Nissan Zaroot SUV **(**see first page**)** with total integration between reflecting surface and incorporated side lighting signals (Figure 13_1 and 13_2).

As a consequence, new technology to wide, rear mirror visibility should be developed [4] to increase rear vision without image deformation and with considerable size reduction.

LED AND ELECTRO-LUMINESCENT ILLUMINATION: INTERNAL, BACKLITES AND PROJECTORS

The first original LED rear illumination was fitted into the holes of semitransparent steel in the Fioravanti Kite concept coupe (see Figure 14_1) and Lexus IS (Figure 14_2), as well as in the Peugeot 107 (Figure 12_4) for LED in head projectors.

In the Renault Zoé, we have already seen embedded LEDs in the transparent glass roof (see Figure 6_2) again shown as a swing glazing roof (Figure 14_3) with laminating technology using sputtered transparent net wiring electric conductors as an invisible net on the laminated glass surface.

In the Nissan Zaroot (Figure 13_1), the projectors are realized with original innovative LED panels

Fig. 15 - Innovative LED panels of the Nissan Zaroot

Fig. 16_1

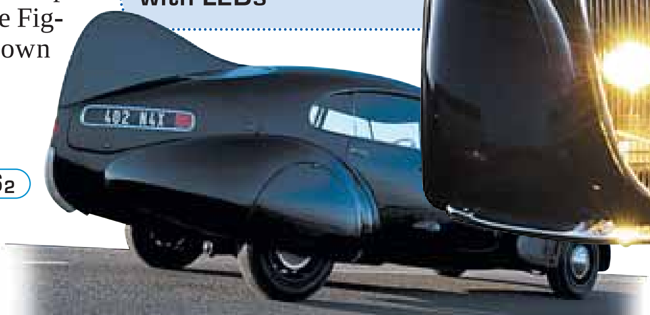

Fig. 16_2

Fig. 16_1 - The Peugeot Concept 402 with LED technology projectors

Fig. 16_2 - The rear number plate with LEDs

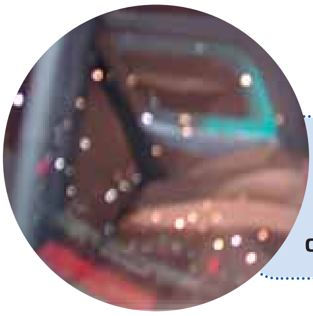

Fig. 17 - Internal electro-luminescent paint for easy location of the internal arms of the door of the Mazda 5

FIG. 18_2

FIG. 18_1

Fig. 18_1 - Lexus New IS by Toyota - aerodynamic body

Fig. 18_2 - Lexus LF-A - another example of aerodynamics

FIG. 20_1

FIG. 20_3

FIG. 20_2

Fig. 20_1 - The innovative Fiat Idea

Fig. 20_2 - Lancia Ypsilon Sport

Fig. 20_3 - The large transparent sunroof of the Zagato concept car

(Figure 15_1) as head lamps on the front bonnet as well as for integrated heat lamps on the roof bars just over the windscreen.

Even on the Peugeot Concept 402, the projectors use LED technology (Figure 16_1) and for both cars, the back number plate (Figure 16_2) has electro-luminescent lightening. Finally, electro-luminescent internal paint was shown in the Mazda 5 (Figure 17) facilitating the location of the internal arm of the door.

FIG. 19_2

FIG. 19_1

Fig. 19_1 - Pininfarina Birdcage

Fig. 19_2 - Peugeot Coursedesign

Consideration

The feeling is that internal, rear and headlamps will be covered mainly by LED and electro-luminescent lighting. The evolution of the transparent glazing area concentrates on shape complexity and, mainly, with large transparent roofs. Shape complexity follows the increasing design of fluent aerodynamic bodies, as in the Lexus New IS (Figure 18_1) and Lexus LF-A (Figure 18_2) (both from Toyota), including concept cars such as the Pininfarina Birdcage 75th (Figure 19_1) and Peugeot Coursdesign fuel cell car (Figure 19_2).

Even Fiat Idea (Figure 20_1) and Lancia Ypsilon Sport (Figure 20_2) see innovation with their increased transparent areas, including Zagato Concept Ypsilon (Figure 20_3) with a larger transpar-

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ent sunroof by *Hard Glass* (Italy).

The increase in transparent areas is shown by the Mercedes cars (Figure 21) where they are compared for their increased transparent areas, mainly for glass roofs and sunroofs.

Of course, the already known Citroen XTR (Figure 22_1) concept car and the Seat Concept (Figure 22_2), designed by Italian architect De Silva, are, once again, typical examples of increased transparent areas and complex shapes with laminated and monolithic glass.

Finally, the Cadillac Ville Concept car presented for the first time at the Geneva Show can be considered the best for large transparent areas of mono-volumes (Figure 22_3).

Consideration

Even if transparent areas have increased considerably, only scanty information has been mentioned media relative to solar control, easy to clean, acoustic thermal barriers, and heatable glasses, which is in line with the Geneva Show, considering them mostly as design evolutions rather then technical and technological.

OTHER INNOVATIVE CONCEPTS AND TECHNOLOGIES

Webasto: fast defrosting and de-icing of the windshield simultaneously spraying and wiping with hot water, by a specially-designed heater in the water spraying container.

Honda FCX: a more advanced fuel cell for clean environment using hydrogen and superior high voltage electricity are differently approached and were very well described by a poster at the Honda stand.

Bridgestone: a new Bridgestone tyre, called "run on flat" (Figure 23) is now available. This tyre does not go flat when perforated. In fact, this is avoided thanks to reinforcement of the sidewalls of the tyre allowing to continue to drive for al least 10-20 kilometres.

Fig. 21 - Increased transparent areas of Mercedes

Fig. 23_1

Fig. 23_2

Fig. 22_1

Fig. 22_2

Fig. 22_3

Fig. 22_1 - Citroen XTR

Fig. 22_2 - Seat Concept

Fig. 22_3 - The Cadillac Ville Concept car

Conclusion

The Geneva Motor Show 2005 can be summarized by the already classical leitmotif of exhibited cars, which pointed out once again the increase in transparent areas using more complex glasses and larger roofs, demonstrating that designers are concentrating more on glass technologies. Internal and external (back and rear projectors) lightings are more and more oriented to the use of LEDs and electro-luminescent technologies.

However, following the main purpose of the Geneva Show, the author's attention was drawn to the present use of emotional technology on the dashboard and trim of the internal compartment design and materials, considerably approaching the matching of windshield shape and its inclination, dashboard shape, colour and surface morphology to improve the comfort and the visibility of the driver and passengers. For the first time, electrochromic glasses appeared on a wide and complex sunroof and plastic-carbon fiber composite and semi-transparent steel plates were used on the external body frame of the car to increase its rigidity.

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[1] G. Manfrè *"Revival and future design at Geneva show 2004"* Glass Technology-International 16/2/2005; pp. 125-131.

[2] M. Nagamachi *"Kansei Engineering I - An introduction to emotional technology to vehicles"* Kaibundo publishing Co. Ltd. (1997) - Japan.

[3] G. Manfrè, P. Carcerano *"Application of Kan-*

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