Experimental study of the Influence of the shock on composite material plates "Sandwich"

Ali. Chaoufi[1], Ahmed. Tafraoui[1]

[1] Laboratoire de Fiabilité du Génie Mécanique BP.417 Route de Kenadza 08000 Béchar, Algérie

Abstract:
Many works are already realized in the fast field of dynamics which is expressed in our case by the request of impact which always remains of news. Associated with the various difficulties of the request of shock the problems of study of composite materials in particular their homogenization or characterization comes to be added. In this objective our present investigation is interested under investigation of the influence of the impact on composite material plates. For an impaction with weight falling a used. The selected structure is plate's sandwich. The tests of characterization carried out then made it possible to supplement the data necessary to the various applications carried out. They got results are treated to be accessible. Keywords: Shock, Plate Sandwich, Deformation, Impaction with falling weight.

I. Introduction

The shock is a request which can arise in various forms and can have an intensity known or not. The effect of the shock can go from simple wave propagation to a total collapse of the structure. On their side the composite materials especially have a very important economic advantage in the fields of civil engineer and mechanics which enter like materials of reinforcement.

II. Composite material

the prone composite material of our study is a material which knows a broad use. Many works completed in the literature touch this field and clarify these uses [10]. II. The Material Sandwich the sandwiches are materials made up of two different parts, one is called: "coating (soles or skins)", the other: "heart (or heart)". The sole is part of great rigidity and low thickness wrapping the heart which has a strong thickness and a low resistance.

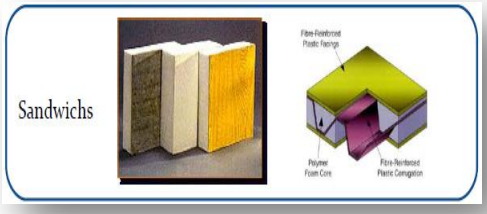


Figure1. Plate Sandwich

II.1 Presentation of Material Used

the composite material sandwich (figure1) used is called composite panel aluminum, the skins are out of aluminum thickness 0.5mm and the heart is in fluorite carbon thickness 3mm what forms the sandwich panel thickness 4mm:

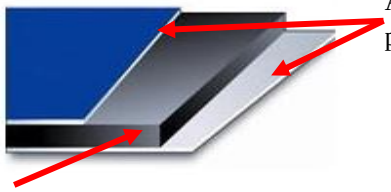


Figure2. Plate Sandwich

In Table1 one finds the various characteristics mechanical of the plate sandwich:

Table1. Mechanical characteristic Plates Sandwich

Plate sandwich	Direction X	Direction Y	Direction Z
YOUNG modulus E(Gpa)	8.085	1.67	1.67
Modulus of rigidity G(GPa)	3.48	1.23	1.23
Poisson's ratio υ	0.16	-0.32	-0.32

And density ρ= 1.11g/cm3 =1110Kg/m3

III. General information on the shock

In general, the shock is recognized as being the vibratory excitation, of which the duration is equal to approximately half of the clean period of the mechanical system. The force of excitation of the shock is defined as being the instantaneous acceleration transmitted to the structure at the point of application or the surface of contact. The answer of the system is expressed in terms of displacement relating to the base of the mass or the absolute acceleration of the mass. II. Definition of an impact in mechanics, the shock corresponds to the application of an important force during a short time, generally accompanied by an abrupt shifting of speed.
The impacts with strong energies often involve the perforation and thus seem to cause the serious damage the low registers. However, one should not neglect the impacts with weak energy because those cause laminations (separation) inside the composites which can be propagated under cyclic request. This phenomenon is insidious because no external sign prevents damage of the composite structure. In the case of an impact leading to the perforation of a plate in composite, one can compare the effect to that of a notch, i.e. with a reduction in the mechanical resistance from approximately 50%. [6, 7.12]

IV. Geometrical condition and in extreme cases

In Figure 2 one can see the data used in this example with knowing the geometrical characteristics of material, the effort of impact applied in Tableau2 table.

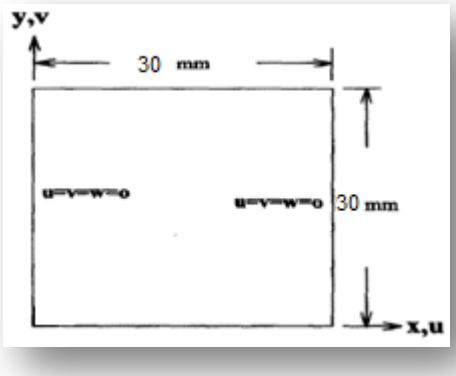


Figure3. Geometrical characteristic and condition of support

The plate is embedded Bi as it is shown in this following photograph

Figure4. Boundary conditions of the plate

the mass of the carriage Impaction is M = 29Kg, by varying the height of the carriage as it is indicated in table 2

Table2. the load of application

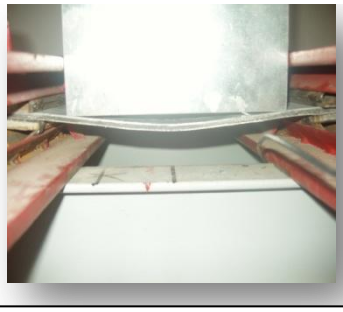
Theoretical energy (J)	Theoretical speed (ms-1)	Height (m)	Traversed time (S)
426.73	5.42	1.50	1.93
483.63	5.77	1.70	2.11
568.98	6.26	2	2.52
853.47	7.67	3	2.92
1137.96	8.85	4	3.33

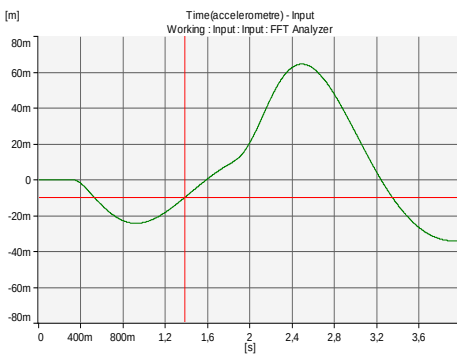
V. Realization of the test of impact

initially, the installation of our plate sandwich is held on the table of support by a fixing bi--embedded using bite adjustable. The centering of the plate makes it possible to ensure the centering of the effort of the impact. Using the reducing gear actuator (with winch), one raises the carriage impaction of constant mass for all the tests with a given height h.
The acquisition of the data being assured numerically then we present in what follows the tests with the results presented respectively the evolution of the displacement of the center of the plate according to time

V.1 Results and discussed

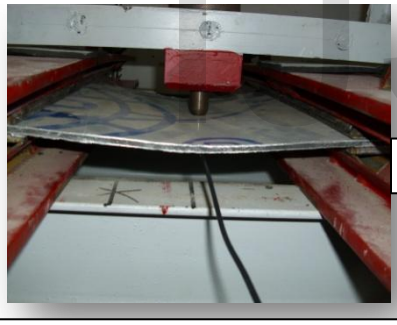
- The Height H = 1,70m

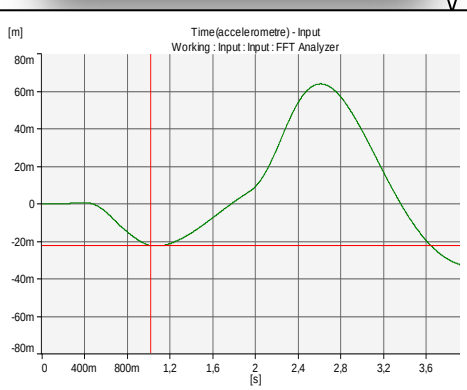




Test plates N°1, H=1.70m
Plaque composite sandwich
Figure5 : Courbe déplacement/temps

- The Height H = 2m

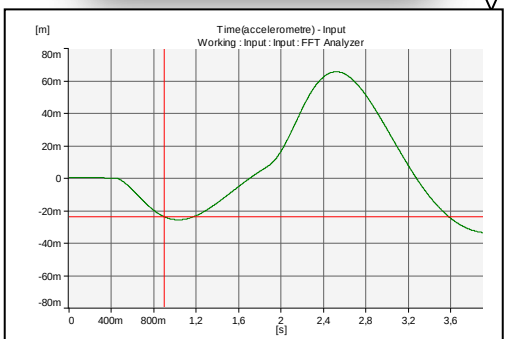




Test plates N°2, H=2m
Plaque composite sandwich
Figure6 Courbe déplacement/temps

A deformation right at the time of the end of the impact which is evaluated with 21mm, after one period stabilizes with the value 25.1 mm. The energy of impact is evaluated to 568.98 J. We note that energy is higher we notice a less deformation

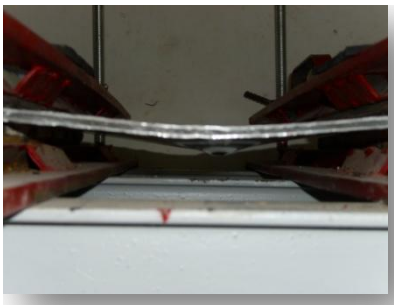
- The Height H = 3m

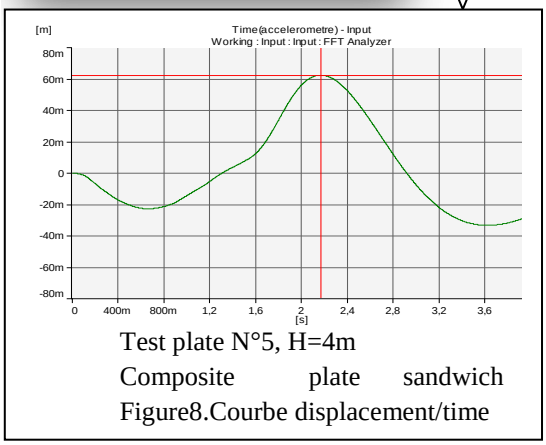


Test plates N°3, H=3m
Plaque composite sandwich
Figure 7 Courbe déplacement/temps

A deformation right at the time of the end of the impact which is evaluated with 22mm and after one period stabilizes with the value 27.1 mm. The energy of impact is evaluated to 853.47 J. We note that the deformation increases with the increase in energy.

- The Height H = 4m

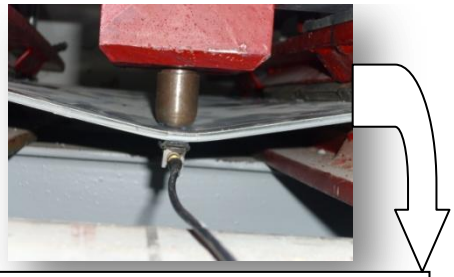


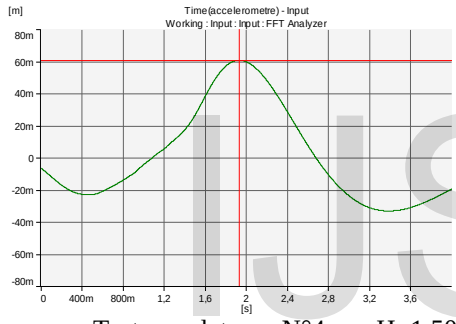


Test plate N°5, H=4m
Composite plate sandwich
Figure8.Courbe displacement/time

We notice a deformation right at the time of the end of the impact which is evaluated with 21mm and after one period with the value 28.5 mm are stabilized. The energy of impact is evaluated with 1137.96J. We note that the deformation increases with the increase in energy.

- The Height H = 1,5m
  In this case we took the point of impact in the center on the free side of the plate of test.





Test plates N°4, H=1.50m Composite plate sandwich
Figure9: Curve displacement/time

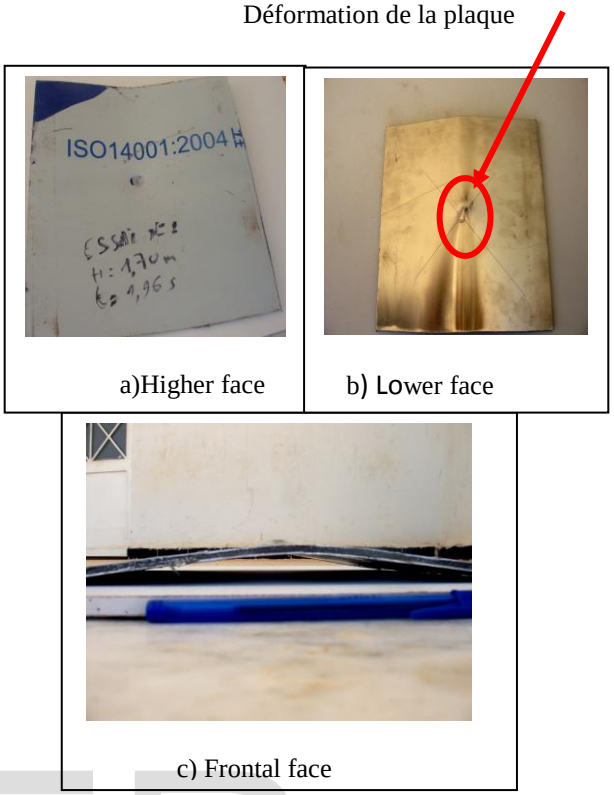
We notice a deformation right at the time of the end of the impact which is evaluated with 21mm and after one period with the value 29.5 mm are stabilized. The energy of impact is evaluated to 426.73 J. We note that the deformation increases even with the reduction in energy.

V.2 Deformation of the plate after the impact

one will show the deformations of the plate with respect to some height which gives us different deformations.

- Lower face Drop height 1,70m

Déformation de la plaque



a)Higher face b) Lower face

c) Frontal face

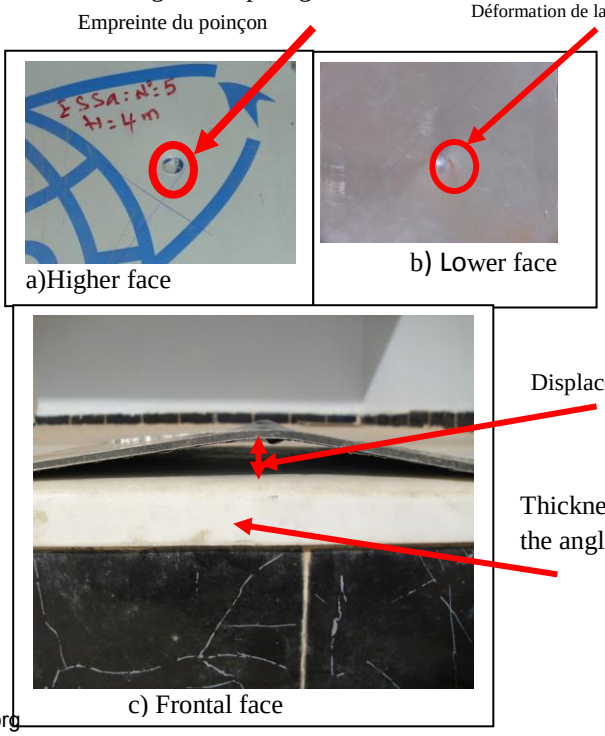
Figure10. Deformation of the plate with h=1,7m

The first test shows that after impact of the plate sandwich there was a deformation, the impactor strikes the plate and continuous to push the plate to the bottom then there was a deformation within the limit of displacement of the plate downwards.
Figure 9 of the frontal face shows the value of the displacement of the plate in comparison with the dimension of the pen with Biro.

- Face higher Drop height 4,00m

Empreinte du poinçon

Déformation de la plaque



a)Higher face b) Lower face

c) Frontal face

Figure11. Deformation of the plate with h=4m

The fifth test shows that after plate sandwich it impacts had a deformation has the lower face, because the impaction has to strike the plate and finishes pushed the plate worm bottom then there was a deformation within the limit of displacement of the plate worm bottom by leaving a print on the higher face of the plate. The figure (3) 10 of the frontal face shows the value of the displacement of the plate compare some with the thickness of the angle.

VI. Conclusion

According to our crash test on the composite material plates (sandwich) shows that they resist the high shock and it can be used in the Civil engineer field that with the Mechanical field with a large security.

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