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AIRCRAFT MAINTENANCE HANGAR

Abstract: *The paper presents the maintenance process that is done on an airplane, at a certain period of time, or after a number of flight hours or cycles and describes the checks performed behind each inspection. The first part of research describes the aircraft maintenance process that has to be done after an updated maintenance manual according with aircraft type, followed by a short introduction about maintenance hangar. The second part of the paper presents a hangar design with a foldable roof and walls, which can be folded or extended, over an airplane when a maintenance process is done, or depending on weather condition.*

Keywords: *aircraft maintenance, line maintenance, aircraft checks, hangar design.*

1. INTRODUCTION

Maintenance is a periodic inspection that is done to most of the airplanes, to ensure that is in good and safe work condition. Maintenance checks can be done in some cases, like after airplane usage or at a certain period of time.

Aircraft maintenance technician is specialized person trained and experienced in a number of processes including troubleshooting, servicing, inspection, installation, removal, testing and repairing.

In aircraft maintenance is no room for mistakes; every aspect should take into consideration such as safety during all maintenance process. Aircraft maintenance technician has a high level of personal responsibility. Every mistake that technician could make can have disastrous consequences, so every inspection is checked and rechecked. Maintenance has to be done according with the aircraft maintenance manual depending of the aircraft type.

2. AIRCRAFT MAINTENANCE

During maintenance process the aircraft is passing to a series of checks. All aircrafts have periodic inspections; the small ones are check quite frequently, after a certain amount of time or usage. There are known different types of checks for large aircrafts, from light routine checks, such as A check, B check, C check, to a long term check or D check. There is a slight difference among checks: A and B checks are considered lighter checks, while C and D are considered heavier checks.

2.1 A Check

This type of check is performed approximately between 400 to 600 flight hours or 200 to 400 cycles, depending of the aircraft type. We consider that a cycle is a takeoff and a landing. For an A check it needs about 150 to 180 man-hours of which more than 10 hours is usually made in a hangar. The occurrence of this check can vary from aircraft to aircraft, and can be delayed by the airline if certain conditions are met. Conditions like the number of hours elapsed since the last check or the cycle count. The check A is a light check and can be performed in a work day or overnight [1].

2.2 B Check

Depending on the aircraft, Check B is performed every 6 to 8 months. Similar with check A it needs about 160 to 180 man-hours. Being a slightly detailed check, may require special equipment and tests, Check B is completed within 1 to 3 days in a maintenance hangar. B check can contain several successive A checks.

2.3 C Check

This type of check is performed every 1 to 2 years depending of the manufacturer specification, at certain amount of flight hours. This maintenance check takes 1 to 2 weeks, with a considerable effort of up to 6000 man hours and can vary depending of aircraft type. For this amount of work is requiring more space than a regular check to be inspected and check most of the components, in the meantime the aircraft is out of service until the check is completed. Due to the large amount of time taking these checks are carried out in a maintenance base in a hangar [2].

2.4 D Check

This type of check known as heavy maintenance or overhaul and is the most demanding check for an aircraft. This check occurs every 5-6 years depending of aircraft type and involves tremendous effort. The aircraft is being disassembled for inspection and in some cases even the paint is completely removed for closer inspection of fuselage for cracks. Depending of the number of technicians involved and the aircraft type this check can take two months and over 50000 man-hours to complete. This kind of operation is required to be performed in a suitable maintenance base in a large hangar equipped with a wide variety of tools and testing equipment necessary for all the stages of maintenance process. The requirements involved in D check maintenance make it the most expensive, with total costs in the million-dollar range [2].

3. MAINTENANCE MANAGEMENT

Good maintenance management plans help the airline industry by keeping the aircraft equipment running safe at high capacity. There are known three levels of maintenance:

- at the organizational level or O level maintenance;
- intermediate level or I level maintenance;
- depot level or D level maintenance.

3.1 Organizational maintenance

The organizational level inspections are been executed at aircraft parking platform or by a maintenance squadron on an aircraft for example the wing.
This maintenance includes daily inspections, fuel supply, lubrication, washing, line replacements units, repair in place procedures, lubrication. For all these inspections and procedures, at this level are no special requirements.

3.2 Intermediate maintenance

The intermediate level inspections are been executed in hangars that are equipped with a wide variety of tools, ground support equipment for repairing and testing procedures.

3.3 Depot level maintenance

Depot level maintenance supports intermediate maintenance and organizational maintenance with tasks that are beyond their level capability and engineering assistance (fig. 1). Depot level maintenance usually takes place in highly specialized repair hangar that has high qualified personnel. The hangar has to be equipped with original equipment manufacturer. At this level is performed a heavy maintenance that require substantial or complete rebuilding.

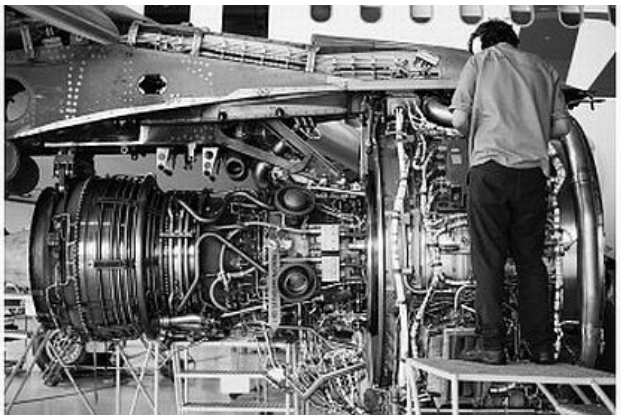

Fig. 1 Depot level maintenance [4].

In maintenance process all the parts that can move under vibrations are fastened to ensure safety and reliability. All the screws are check and those that were disassembled are fixed with locking paste and safety wire.

4. AIRCRAFT MAINTENANCE HANGAR

Aircraft hangar is space used to maintenance operation or store an airplane. Hangars can be used to protect an airplane when the weather is not in good condition for outside storing. Sometimes the bad weather can cause damage such as dust contamination or corrosion. Hangar is usually larger than the aircraft itself to ensure maintenance operations safely around the aircraft (fig. 2). In terms of size hangars can be huge to store multiple airplanes.

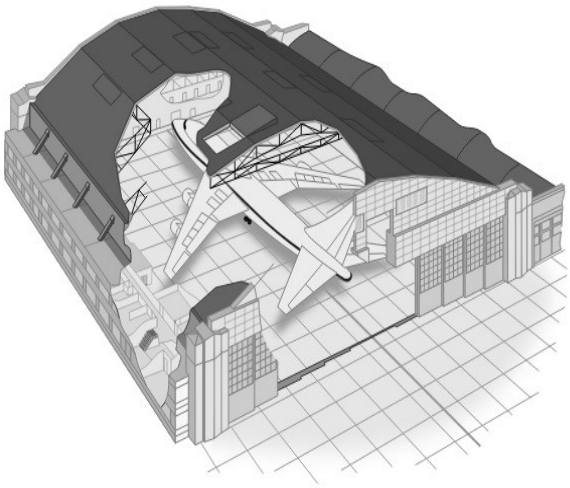

Fig. 2 Hangar diagram [3].

According with the size of the span hangars are classified as:

- small hangars with a span of less than 30 m;
- medium hangars with a span between 30 - 60 m;
- large hangars with a span between 60 - 90 m;
- extra-large hangars with a span between 90 - 120m;
- extra extra-large hangars with a span more than 120m;

5. AIRCRAFT HANGAR DESIGN

Most of the time maintenance cannot be done outside, because of the weather condition or light. For this is needed a controlled environment and the maintenance process and checks is done in a hangar. Hangar design must be kept simple and ensure easy access of the personal and aircraft. It must be equipped with tools needed, electric source and compressed air hose.

The airport is a busy place and every inch is used. When an airplane is not used for a period of time is parked in a place unused for landing and take-off next to one side of the runway. In the parking lot the aircraft is protected with a cover (fig. 3).

Fig. 3 Airplane with protective cover.

Because the aircraft is not entirely protected, but only just a part of it, the best way to keep it safe is by storing in a hangar.

Designing a hangar with extendable roof could be a solution by dragging the roof of the maintenance hangar over a parked airplane. This will combine both the maintenance hangar and a small parking lot using a solid commune platform (fig. 4).

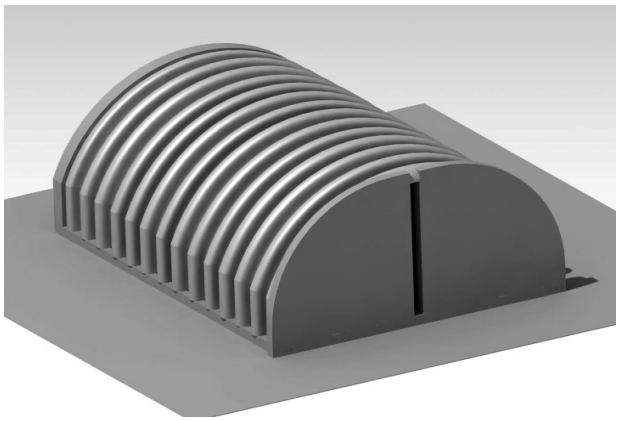

Fig. 4 Hangar design.

The hangar has a solid base build at ground level to ensure easy access with aircrafts, and with small sets of linear rails on each side for guiding the retractable walls and roof. Here can be used a wide variety of sliding tracks, these can be adapted using the same principle used at retractable sliding fence.

The hangar can be designed in multiple ways depending of the material used and applicability. First design can be build using the same principle of retractable sliding fence (fig. 5) as a frame and for the cover can be used an impermeable fabric to cover the entire frame, creating an extendable roof and wall over the parked aircrafts.

The second design can be build using solid metal plates connected together with joint using the principle of "VARIFOLD" folding technology (fig. 6).

Fig. 5 Retractable sliding gate [5].

When is applied a similar system of retractable sliding gate can also be used the withdrawal system, to use automatic retraction system.

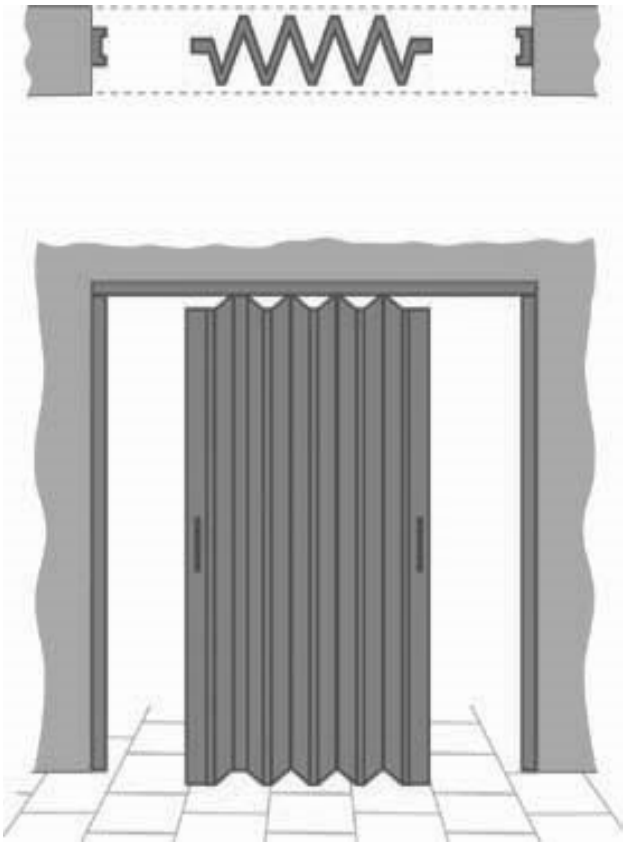

Fig. 6 Varifold wall panels [6].

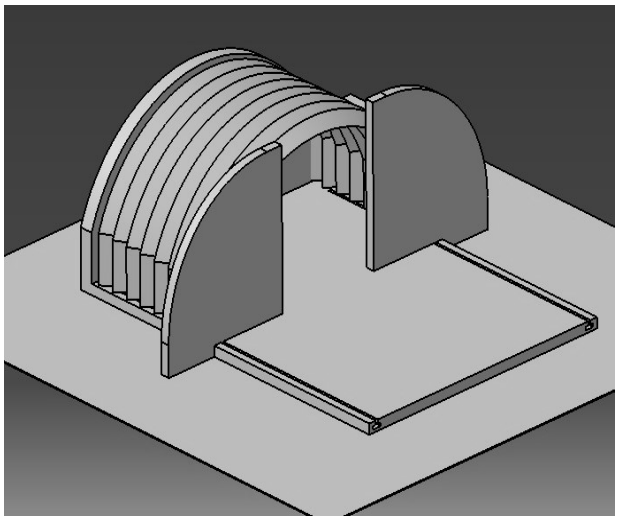

Fig. 7 Folded hangar design.

The folded hangar design can be used when a maintenance process is started on the platform on open sky, and weather conditions is getting worse, it is more convenient to drag the roof and walls (fig. 7) over the disassembled plane instead of moving the parts inside a hangar.

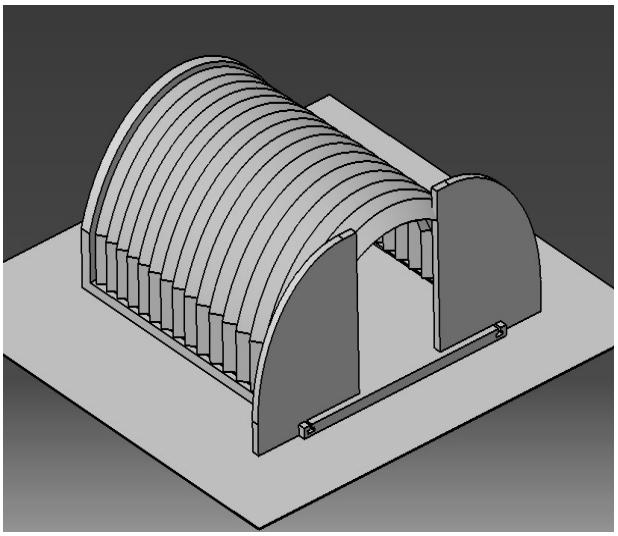

Fig. 8 Hangar design.

The foldable hangar design (fig. 8) can be used in some cases of airplane restoration process when a plane is painted or the paint is removed for fuselage inspection and is needed a fast ventilation of toxic vapours.

6. CONCLUSION

Aircraft maintenance is a controlled process carried out at predetermined intervals of time, conducted by an aircraft technician, in order to reduce or avoid potential damage, and maintaining flight equipment in good condition.

Further research can be done in terms of placing the hangar and materials needed.

The proposed hangar designs can be a solution for space saving and maintenance management.

The hangar design and be used in multiple situation, from maintenance to inspection checks and airplane restoration.

REFERENCES

[1]http://www.bangladeshmonitor.com.bd/prints/front_page/7 *Accessed*: 2017-01-20.
[2] http://www.aircraftengineer.info/category/wiki/
[3] https://en.wikipedia.org/wiki/Hangar *Accessed*: 2016-12-26.
[4]https://www.behance.net/gallery/33701400/Introduction-to-Depot-Level-Maintenance
[5] http://www.automaticfoldinggates.com/sale-2697739-industial-grade-trackless-automatic-folding-gate-with-aerodynamic-design.html
[6] http://www.tallilliserrande.it/pore-a-soffietto.html
[7]https://www.faa.gov/regulations_policies/handbooks_manuals/aircraft/amt_handbook/
[8] Belless, R. and Anderson, L., (1970) "*Needed: Space Maintenance Tools*," SAE Technical Paper 700619, doi: 10.4271/700619.
[9] GEROR, R., (1949) "“*On Condition*” *Maintenance,*" SAE Technical Paper 490066, doi:10.4271/490066.

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