

Design for a Military weapons system.

by Scott Ling

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Figure 1 Apache with Hellfire missile [9]

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Contents

Table of figures.....	2
Introduction	2
The delivery platform	2
The target	3
Guidance system	3
Fragmentation Bomb/Blast Missile	3
<i>A fragmentation bomb-</i>	4
<i>A blast missile-</i>	4
Requirements of the missile.....	4
Performance	4
Environment.....	5
Design	5
<i>Seeker Section</i>	6
<i>Strake</i>	6
<i>Warhead section</i>	6
<i>Propulsion section</i>	6
<i>Wing</i>	6
<i>Canards</i>	6
<i>Control section</i>	7
Safety.....	7
• <i>Examining the design of the weapon</i>	7
• <i>The environment</i>	7
• <i>Review of the safety features</i>	7
• <i>Monitoring of tests</i>	7
Manufacturing.....	8
Testing	8
Storage and handling.....	9
Lifecycle process	9
Summary.....	9
Bibliography	10

Table of figures

Figure 1	Apache with Hellfire missile [2]	0
Figure 2:	Typical layout of a hellfire or similar warhead [5].....	6

Introduction

A request has been raised by the military for a guided missile to be designed and delivered by a specified aircraft for the destruction of a specified target.

In this report the author will write briefly about the delivery platform that will be used to carry the designed missile, as well as referencing the intended target. To be able to fulfill this the brief the author will work through the process that is required in the design of a missile as well as fulfilling the requirements of the brief.

The likely specifications will be considered at the request of the customer. Due to the limited details that have been produced by the customer in the brief, the author will make assumptions which will be used to be able to achieve the essential requirements that need to be included.

This report is written on a hypothetical basis and academic purposes, and no personal opinions are expressed within this report.

The delivery platform

The delivery platform that has been chosen to carry the designed missile will be an Apache. The designed missile will need to fit on the firing rails that are mounted to pylons on the wings of the Apache. There is two pylons on each wing and each pylon can carry four missiles per pylon. This enables the apache to carry sixteen missiles for one mission.

For the purposes of this report in depth specifications regarding the delivery system is not required, however there is certain requirements that the missile will be required to meet and be compatible with the delivery system. These are as follows;

- Weight
- Size
- Mounting to the delivery platform

These requirements will be covered in the requirements section of the report. [1] [2]

The target

When designing a missile an important point to consider is the construction of the target. Multiple effects can be reached on the target depending on the variation of the weapons system that is being used, these effects will vary upon the construction of the chosen target.

A weapons system that is used for anti-personnel/un-armored or lightly armored vehicles will not have as much of an effect as that of a weapon that is designed to destroy heavy armour or reinforced concrete structures. This is due to the properties or the explosive composition having different effects during detonation of each system.

The information that the customer has provided is that the target is a steel structured with a metal clad exterior weapons storage facility. The requirement is to destroy this facility as well as the contents that are stored inside.

The target is in a location that could cause effects on the missiles due to the climate of the location, this will be discussed further into the report.

There is also a requirement to minimize any damage to infrastructure in the surrounding areas and keep the risk of civilian casualties to a minimum.

Using the information the customer has provided the author will assume that the clad exterior is made of aluminum.

Guidance system

Guided weapons systems are guided by a selection of guidance systems. These are controlled by satellite, laser or by RF (radio frequency). A satellite weapon system is guided by GPS co-ordinates, these co-ordinates that are programmed to the device will cause the weapons system to travel to the specific location. A laser weapons system is controlled via the platform that it is released from, from a buddy aircraft or by personnel on the ground, the laser will illuminate a specified target which the sensors inside the missile will acquire. RF controlled weapons system will use a camera on the front of the weapons system this will be controlled by an operator inside the weapons platform. [2] [3] [4] [5]

Fragmentation Bomb/Blast Missile

Knowing the information regarding the target the next step in the process would be choosing what effect is required. The customers requirement is to destroy the target, as well as keeping civilian casualties to a minimum as well as minimal damage infrastructure. There are two effects that will be considered, these are as follows;

- Fragmentation bomb
- Blast missile

A fragmentation bomb- is where you have a charge filled with HE (High Explosives) inside a container. When this detonates it propels fragments from the case outwards at high velocities. A blast bomb is usually dropped onto a target due to the size and weight. A fragmentation bomb is usually made of a heavy case material. This type of effect can cause considerable damage to surrounding infrastructure as well being lethal to military personnel and civilians that are in the radius of the blast. The fragments can either come from the case itself or can form as a result of detonation.

A blast missile- is where the payload is to achieve the required damage level from the blast and shockwave. The payload used in this type of war missile is HE (High Explosive) or thermobaric/fuel air, which upon detonation produces high pressure that will propagate from the center of detonation. Although this is a blast missile there is a secondary wave of damage at this is caused by the casing that the payload was confined in prior to detonation. A blast missile will use the onboard guidance system to reach its target. A blast missile is usually manufactured from a light weight material for it to be able to maneuver during flight. [3] [4]

Requirements of the missile

There are multiple categories of requirements that need to be considered when procuring the system. These are as follows; manufacturing capability, performance, safety, storage and packaging. These are the overarching requirements for the system itself. The customer will have more streamlined requirements such as; cost, delivery mechanism or in the case of this report it will be a guidance system.

The requirement of the missile is for it to destroy the intended target, as well as keeping civilian casualties to a minimum as well as minimal damage infrastructure.

PERFORMANCE

- The missile will need to have sufficient power to destroy the intended target. This is the main requirement from the customer, if this criteria isn't met then this brief will be classed as a failure.
- The device must engage when it is programmed to and not before. If this happens prior to arriving at the intended target, multiple criteria's from the customers brief have not been met. If the missile was to prematurely detonate, surrounding infrastructures and civilians will be in danger.
- The missile must not damage the platform system upon firing.

To achieve the first requirement, the correct explosive composition will need to be chosen for the missile. To be able to achieve the required blast effect a thermobaric or enhanced blast warhead should be considered.

When it comes to ranges of the missile, this maximizes the platforms survivability and lower the risk to the platform crew the points to consider are as follows;

- What ranges will the missile be operated over,
- The size of the target,
- Accuracy of the missile.

[3] [4] [5]

ENVIRONMENT

When designing a missile the intended environmental factors will need to be taken into consideration. There are multiple factors to consider during the design stage, these factors and their description are as follows:

- Temperature (rise and fall of temperatures can affect the explosive composition of the missile). This will cause the composition to crack and will degrade the propellant.
- Aircraft vibration- With the missile being mounted to the platform during flight the missile will be subjected to turbulence as well as G-force if the platform needs to take evasive action. Stress to the composition will create cracks and hotspots this could cause the missile to initiate.
- Air pressure/Altitude- will the air pressure or altitude affect the performance of the missile.

These points will need to be taken into consideration when testing the missile as failure of any of the above points will result in the requirement criteria not being met.

All materials should have minimal environmental impact. [3]

Design

When designing a missile there are basic requirements that need to be met these are as follows;

- Sufficient speed and maneuverability to be able to intercept the target,
- Damage is sufficient enough to neutralize target,
- Launches when need to,
- Missile and components need to be safe to handle.

For the purpose of this report the following design will be carried out;

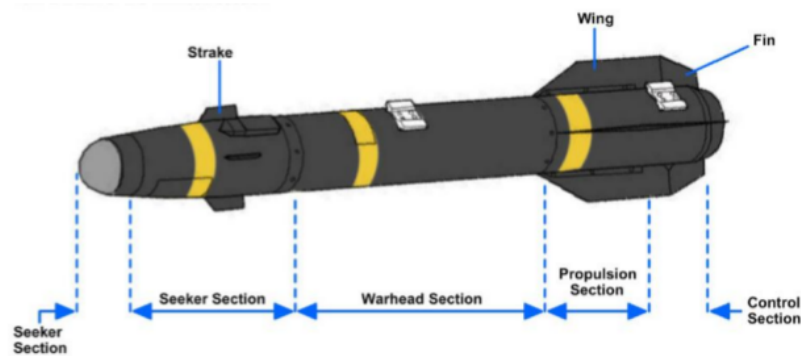


Figure 2: Typical layout of a hellfire or similar warhead [5]

Seeker Section

The seeker that will be used on the missile will be GPS. GPS guidance system is more accurate than that of laser guidance, this is due to laser being able to be obscured by smoke, or weather conditions. GPS can be affected exploited but this is unlikely to have an effect during a tactical situation

Strake

The strake sets are used to change the aerodynamics of the weapon systems which will improve and give greater aerodynamics.

Warhead section

The warhead section is designed to inflict as much damage to the target as possible.

Propulsion section

The propulsion section of the missile will provide the required thrust from the mountings on the platform. The missile will be propelled by a single stage solid-propellant Thiokol TX-657 rocket motor. The launch motor on the weapon system will have a soft launch effect to free it from the platform system. Upon launch the main motor will initiate this will have a slotted straw to enable a faster burn. The flight motor will have a solid grain this will enable regular burn and regular velocity.

Wing

Wings are incorporated on a missile to help with stability.

Canards

Canards at the front of the missile provide maneuverability during flight and also aid in stability.

Control section

The control section will receive commands from the auto pilot within the guidance system, this enables the controller to administer stabilization for the missile. [3] [4] [5]

Safety

Safety needs to be considered as a feature from the concept stage right through to the development stage. When designing the weapon system communication is key between the designer, project manager and manufacturer. The environment in which the weapon will be used, stored and transported, throughout its life-cycle must be fully considered.

The required aim is to develop a weapon that is safe in service without adding constraints to the designer or reducing the weapons performance. This can be achieved by means of assessment.

A means of assessment has four stages and these are:

- **Examining the design of the weapon**- This will include all the components used within the weapon, ignition of weapon, Safety features within the weapon.
- **The environment**- This will include climate, electrical, electromagnetic and mechanical.
- **Review of the safety features**- This will include examination of the intentional means of initiation, and how it is protected by its safety features.
- **Monitoring of tests**- This will be analyzing the results that have been achieved through the earlier tests and developing them if needed.

Other safety features to take into consideration are:

- The designed weapons system will need to be safe to store following the predefined conditions of the weapon system lifetime. Failure to meet this requirement, will result in deterioration of the weapon system. The deterioration of the weapon system can be caused by temperature changes this will have an effect on the composition. Environmental factors will need to be considered for the effect on the sensitivity of the weapons systems composition.
- The device will need to be able to transported safely and deployed. Must be sensitive enough to detonate when required but not sensitive if exposed to threats to the missile itself. This will be achieved through the safety and arming mechanism within the missile. [3] [6] [7] [8]

Manufacturing

- Ease of manufacture will need to be considered in design.
If the complexity of the system is too much for that of the manufacturer this will lead to extended build time and deadlines not being met. There is also the potential for personnel to be injured during manufacturing.
- Availability/Access to materials required for the build. Following on from the points mentioned above, if the materials, that are required are in a limited state or too expensive to purchase or manufacture then this will not meet the customer's requirement.

Testing

Upon completion of the design and construction of the missile, a test regime would need to be carried out before the missiles are able to be commissioned. If a new explosive composition is manufactured there tests that are required to be undertaken by EMTAP (Energetic Materials and Assessment Policy) manual, some of these test are as follows:

- Friction test,
- Temperature required for ignition,
- Mallet test,
- Mechanical properties testing.

These tests are required when a new composition is made to conform to military safety guidelines.

These tests would include:

- Distance – The range that the delivery platform is required to be away from the target to be able to successfully execute the target. This would need to be known by the customer, as this will account towards Platform survivability.
- Platform release- An inert version of the missile will be made to the missiles specifications this will then be attached to the platform to test firing mechanisms
- Component testing- The components will need to go through various test for compatibility and defect analysis. Compatibility of all energetic fills with cases will need to be carried, this is important with thermobaric mixes due to solvents being produced. These test will consist of: vibration testing, heat testing, and temperature variation testing.
- Computer modelling undertaken on the warhead effects and the capability, thrust profile etc. of the rocket motor prior to manufacture.

The component testing will be carried out at the sub-system stage, by doing this it allows the manufacturer to address any failures or design issues that have been recorded during the testing stages. This will allow the re-design at an early stage of the process.

A penetration test will be carried on a rocket under the predicted speeds of the missile to record the depth of penetration. This test can be replicated using computer modelling. [7] [8]

Storage and handling

Storage and processing will be at the FOB that the platform system is based at, this facility will have facilities to be handle and store the missiles. The FOB, will be conforming to all relevant regulations regarding OME. [8]

The munition will only be handled in the suitable packaging, unless it is being loaded/unloaded from the platform or during processing.

The missile or missile components should and will be earthed when being processed. RF shielding for packaging will be required. [3] [6] [7] [8]

Lifecycle process

The lifecycle process of a weapons system will need to be considered upon design. These will need to conform to the military/government guidelines. Once the missile has been deemed to have met its end of life there needs to be a process in place to dispose of the item.

This can be a render safe break down where the missile is stripped down into sections where the parts and components could be re-used on the newer weapon system if they are compatible. The explosive composition would need to be destroyed this could be met by a controlled burn. This can be achieved relatively local to the task being carried.

Another means of disposing of the weapon system is to do a controlled demolition. This would involve additional explosives and detonators and forcing the composition inside to detonate. This process will require a large cover area due to the process of detonating the missile.

Both these process will work, however the areas that the missile are contained in will dictate which process is more suitable.

Summary

In summary to this report a design of a missile has been fulfilled, however the costing for the design was out of the scope of this report at this time.

The missile design has captured all the customers' requirements to a satisfactory level.

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Design for a Military weapons system.

GRADEMARK REPORT

FINAL GRADE

GENERAL COMMENTS

Instructor

49/100

PAGE 1

PAGE 2

PAGE 3

PAGE 4

PAGE 5

PAGE 6

PAGE 7

PAGE 8

PAGE 9

PAGE 10

PAGE 11

PAGE 12

GRADING FORM: SMU GENERIC_GJ

SCOTT
LING

48.80

RESEARCH-INFORMED LITERATURE

-  Environmental, performance and technical references made **6**

KNOWLEDGE AND UNDERSTANDING

-  Basic knowledge is there but the report needs better organisation to get the points over **15**

ANALYSIS

-  "The knowledge is there but a better structure would help the reader. Consideration of the manufacture to disposal sequence and taking requirements, functions and solutions through in the same logical order would help. We get into a bit of a hotch potch of answers sometimes." **15**

PRACTICAL APPLICATION AND DEP.

-  Use of systems thinking and or other design tools and tables would help, especially in the requirements analysis **8**

SKILLS FOR PROFESSIONAL PRAC.

-  Report style a little disjointed. A read through might

have helped clarify some of the language used

4.8