



Multi-stage Rocket Concept



Multi-staging Strategy

Multi-staging in rockets is the design **strategy** that aims to **make** ascent missions more efficient by **dividing** the total **rocket** into a number of **sub-rockets**, called stages.

Typically, each **sub-rocket** is a complete **rocket** by itself and at the **end** of its burnout, **shell** & other inert **mass** are separated from the **remaining** rocket.



Multi-staging Design Strategy

Thus, after **each** stage is over, **starting** mass for next **stage** is significantly **smaller**, as **inert** mass is **removed**, causing a **reduction** in the energy **loss** due to **gravity**.

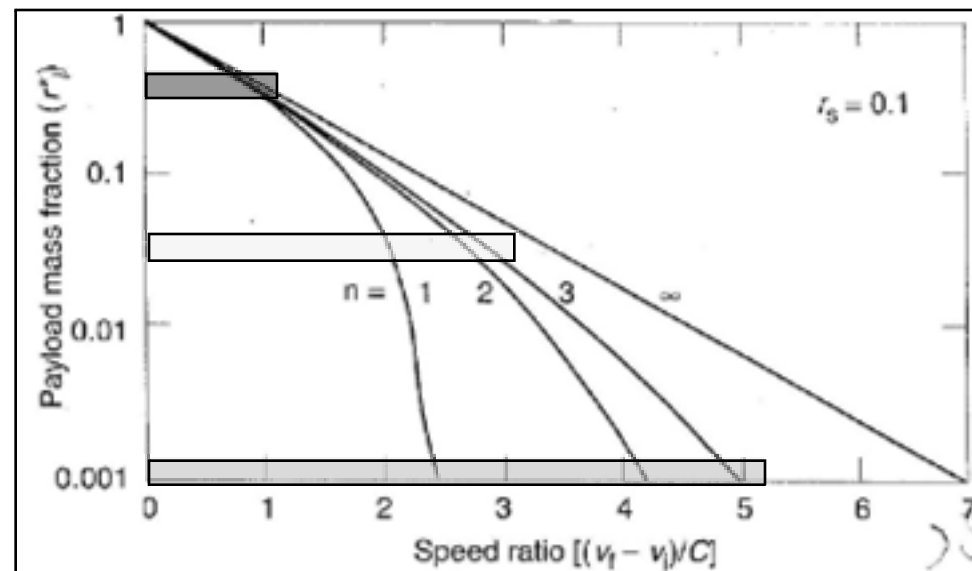
Further, it also **enables** the use of **dissimilar** technologies e.g. propellant, structure etc. in the **same** vehicle mission.

However, **multi-staging** makes the mission **design** and implementation, lot **more** complex.



Impact of Staging

Following **plot** brings out the **benefits** of multi-staging.



Staging **issues** overtake **benefits** beyond 3-4 stages.



Multi-stage Design Philosophy

Staging is carried out **under** the following **guidelines**.

Each stage is a rocket by **itself**, with its **own** propellant and structure (including systems) **mass**, while final **payload** mass is separately **prescribed**.

Propellant type in **each** stage can be **different**.



Summary

Thus, to **summarize**, multistage rocket design **provides** significant benefits for the **efficiency** of the mission.

However, these **benefits** rapidly decrease with **increase** in number of stages, while other **operational** complexities increase significantly, **leading** to a cap on No. of stages.