IDC - IIT BOMBAY

DRS 660

Design research seminar report

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Nature inspired

Food dispersal packaging

For flood calamity

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Guided By

Prof. Vijay Bapat

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Presented By

Rajat

176130006

INDUSTRIAL DESIGN

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Approval Sheet

Design Research Seminar Course

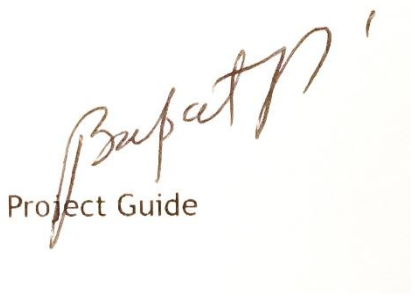
"Nature inspired

Food dispersal packaging

For flood calamity"

RAJAT
M.Des in Industrial Design
2017-19
176130006

is approved for the partial fulfillment of the requirement for the Post Graduate degree in Industrial Design.



Declaration

I declare that this written submission represents my ideas in my own words and where others ideas or words have been included, I have adequately cited and referenced the original sources. I also declare that I have adhered to all the principles of academic honesty and integrity and have not misrepresented or fabricated or falsified any idea/data/fact/source in my submission. I understand that any violation of the above will be cause for disciplinary action by the institute and can also evoke penal action from the sources which have thus not been properly cited or from whom proper permission has not been taken when needed.

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IIT Bombay.

Acknowledgement

Firstly, I would like to express my special thanks and gratitude to my project guide Prof. Vijay Bapat, without whom this project would not have been possible. And I would also like to thank my friend Enlin & Maddu for helping me out for conducting Drop test.

Lastly, I would also like to specially thank my family and friends for being my support during project time.

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Contents

Problem Identification

Presently, the food dispersal in flooded lands and condition is by dropping one or more big & bulky packages of food. This causes damage of food items due to impact with ground, which can also result in food contamination by exposure to environment around it. This kind of delivery results in chaos within people, improper food distribution & waste of food due to damage caused by people handling it. The food items are damaged especially when variety of items are mixed together and dropped in a single attempt.

Design Approach

The problem solving approach for the above issues is to be inspired from Nature. Majorly, the way of dispersion of seeds/Spores for Survival, as in the Plant Kingdom. The Biomimetic or Bio-mimicry forms the basis for the Design direction for this project. The Prototypes are to be tested by Drop test and the time of flight/drop achieved would be a major factor in deciding on the final design.

Design statement

To design a food packaging for food dispersal during flood calamity.

Design Objective

To deliver the food packets safely in smaller units.

Design Considerations

[The Must Haves]

- Ease of Manufacturing
- Fast & Ease to wrap
- Stackable
- Eco-friendly

CONCEPT 1

The Rolling Flower of Bougainvillea

Fig. 1

The combination of three petals surrounding a core and their shape, helps the shaded flowers to roll by wind and get dispersed to distances on ground.

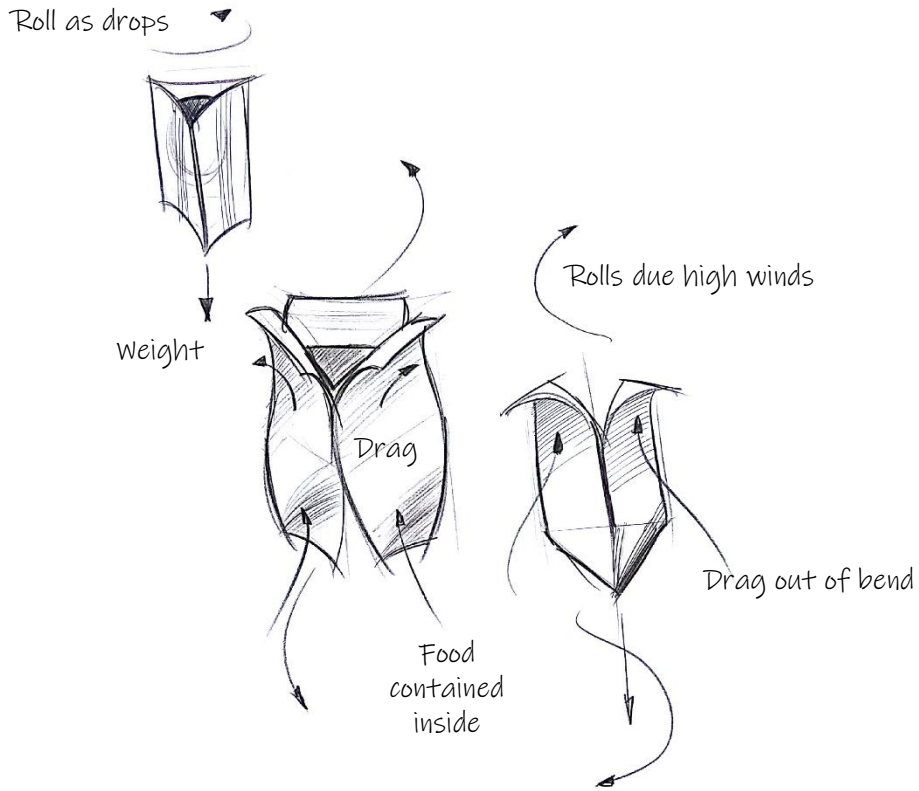
The idea was to make use of this surface expansion and petal combination to increase the drag during the drop.

Result from drop test:

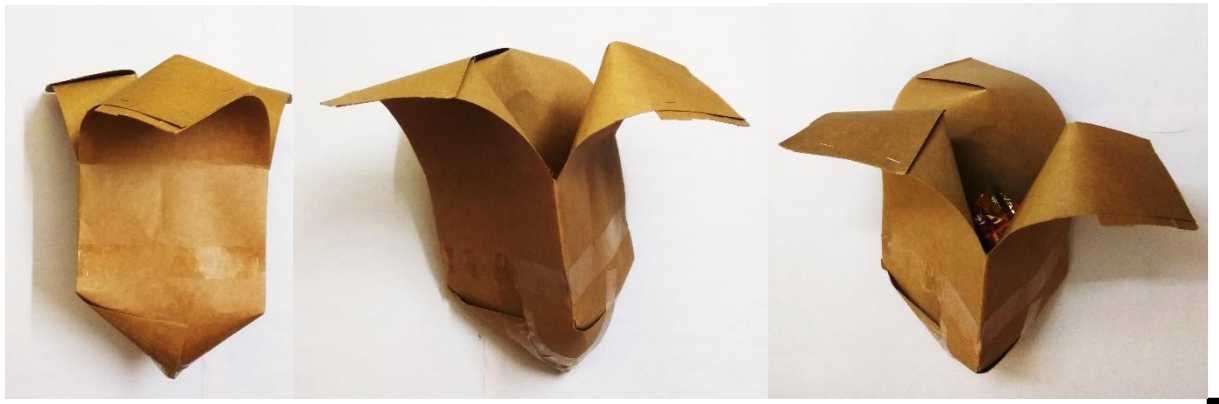
Time of drop from 20 m high- 4.94 sec

This design showed a gradual drop as it rolls over the wind current while it falls down.

Ideations & Mock ups



Mock up model



CONCEPT 2

The Spinning fruit of Thailand

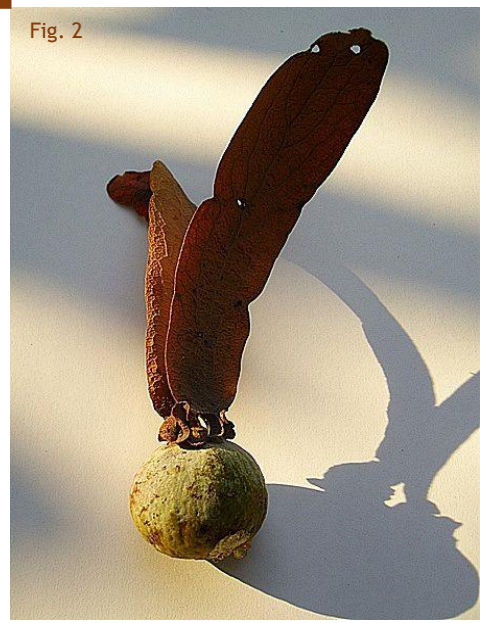


Fig. 2

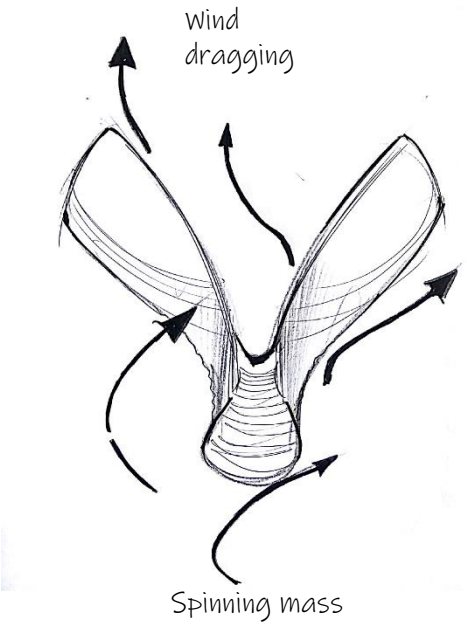
This spinning fruit of Thailand (Diptocarpus obtusifolius) has two leaves flaring symmetrically in opposite direction. This pair of leaves helps the fruit to spin in the air. It also disperses the fruit and reduces the dropping velocity. The idea was to use this twin leaves arrangement to disperse and drop the food gradually.

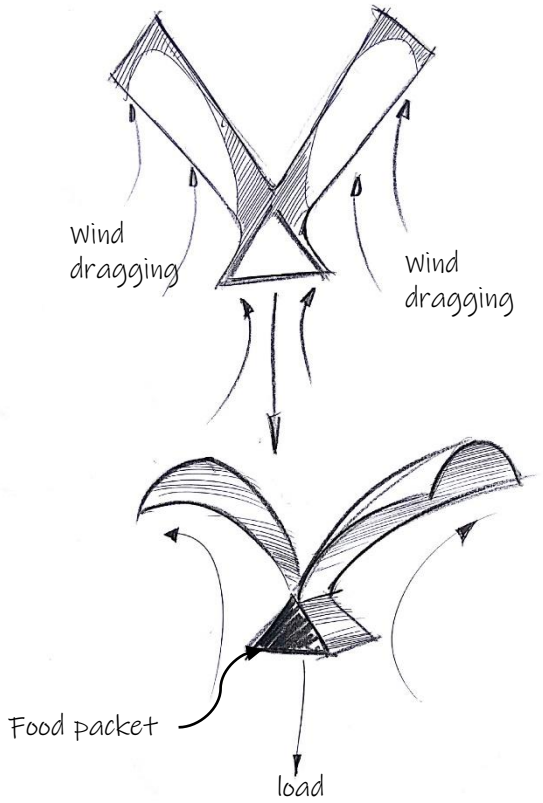
Result from drop test:

Time of drop from 20 m high- 3.87 sec

This design spins as it comes down and falls on its base properly on the ground.

Ideations & Mock ups





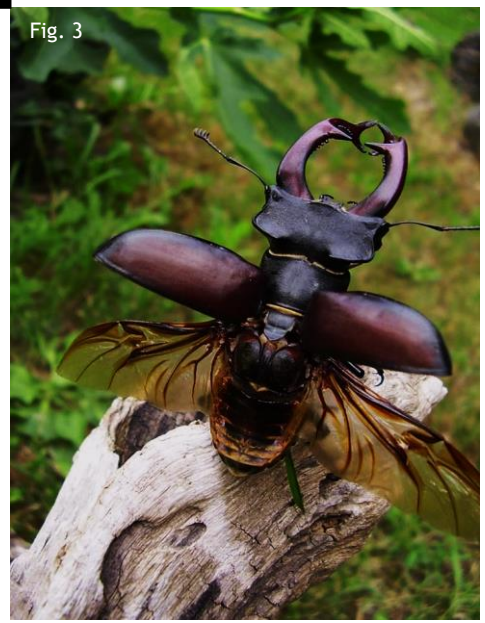
Mock up model

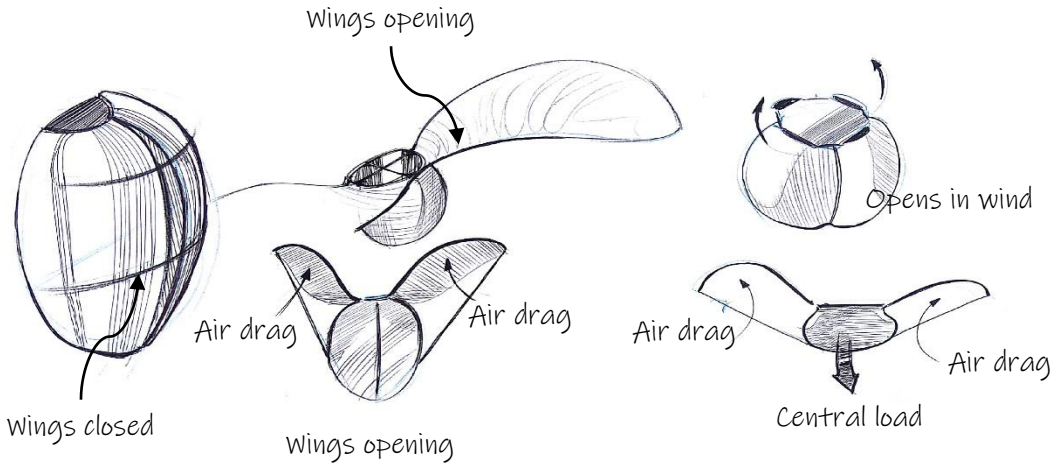
CONCEPT 3

Ideations & Mock ups

The Wings of Black beetle

Fig. 3





The beetles have an extra cover-like wing to increase the drag over the bulky body during they fly. The cover also protects its expandable pair of wings that facilitates flying.

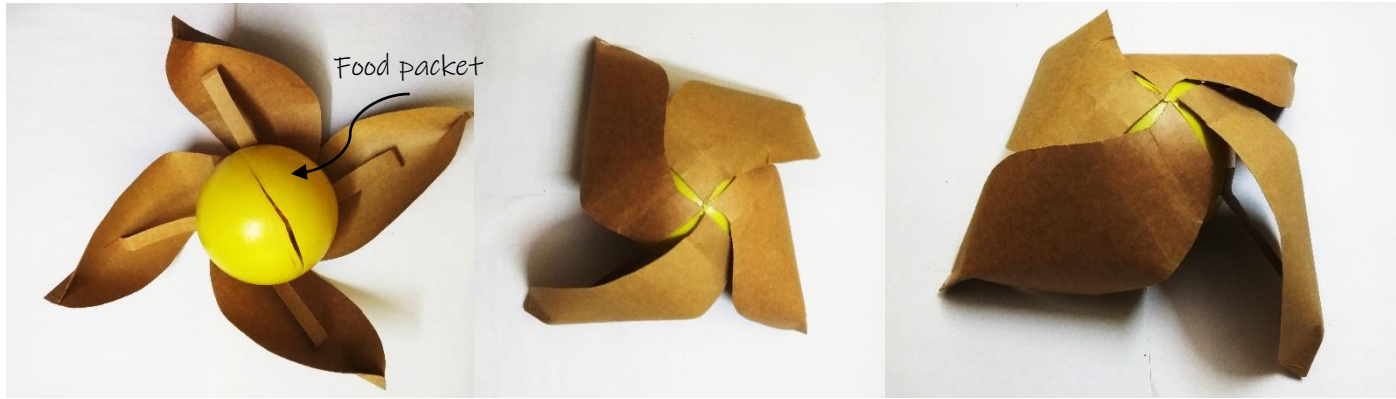
The idea was to take inspiration from this way of increasing drag over an bulky body.

Result from drop test:

Time of drop from 20 m high- 4.60 sec

This design does not create sufficient drag to avoid fast drop to serve the function.

Mock up model



CONCEPT 4

The copter Maple Seed


Fig. 4

The dynamic imbalance in the structure of a maple seed aids these seeds to fall and spin like a copter above ground.

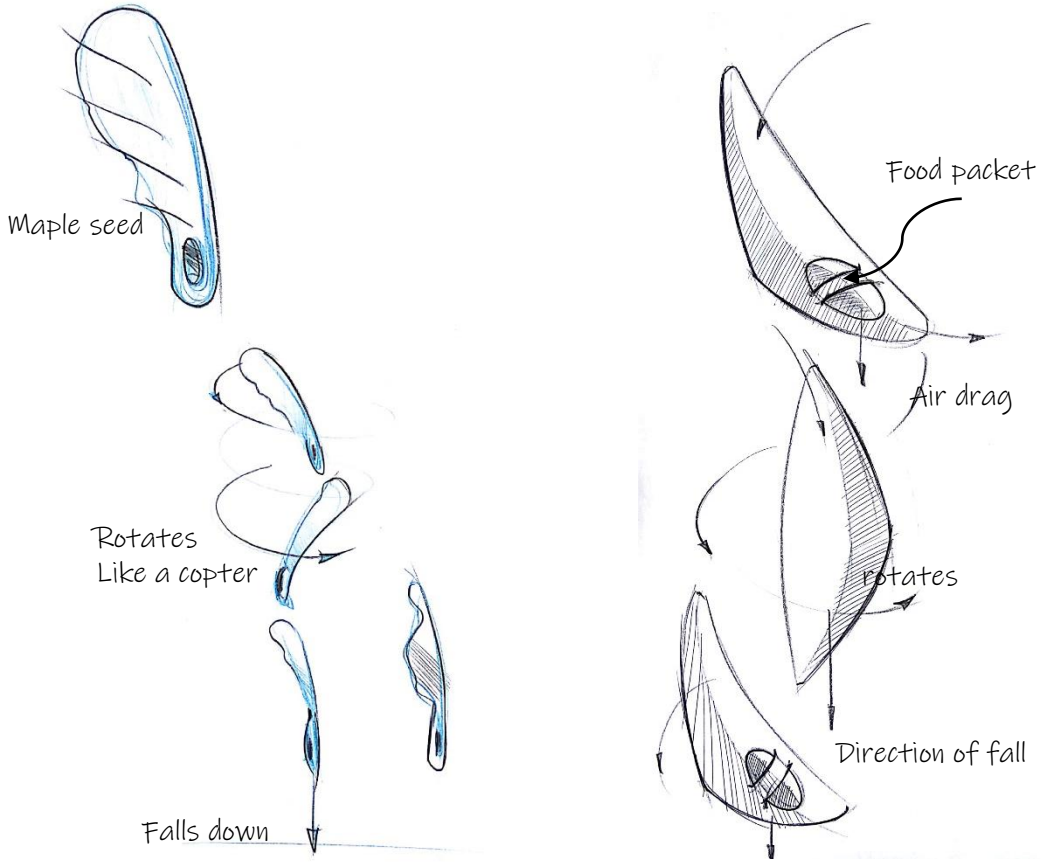
The idea was to take inspiration from this minimal asymmetrical design to achieve similar motion.

Result from drop test:

Time of drop from 20 m high-8.13sec

This design starts to spin after some time of flight and result in almost straight gradual drop.

Ideations & Mock ups



Mock up model

CONCEPT 5

The Bloom of Mushroom


Fig. 5

The mushroom blooms to increase the exposure of its spores to disperse them away in the wind.

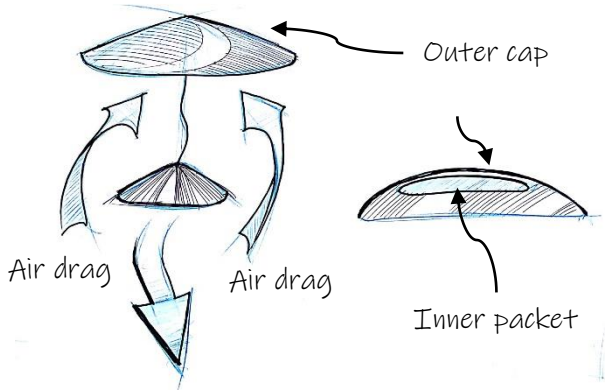
The idea was to make use of this blooming expansion phenomenon to increase the drag in the package delivery.

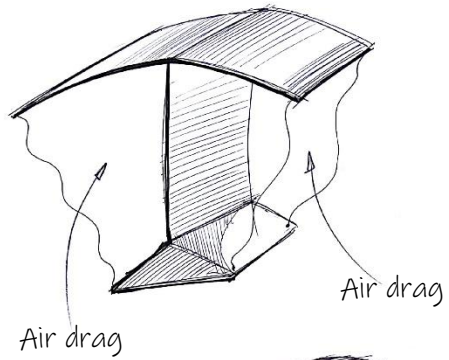
Result from drop test:

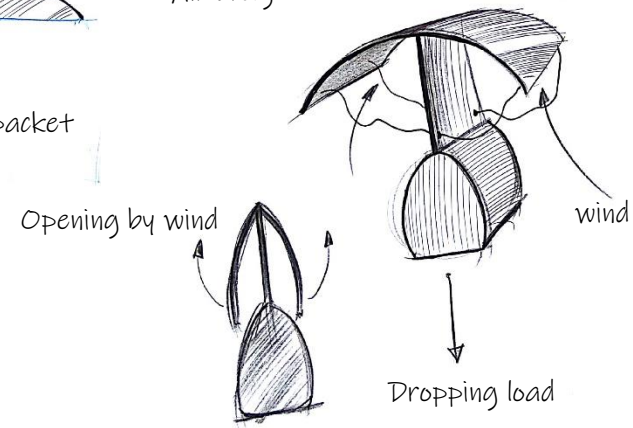
Time of drop from 20 m high- 4.97 sec

This design showed an unbalanced and inefficient drop as it tilts after one side of cap is opened.

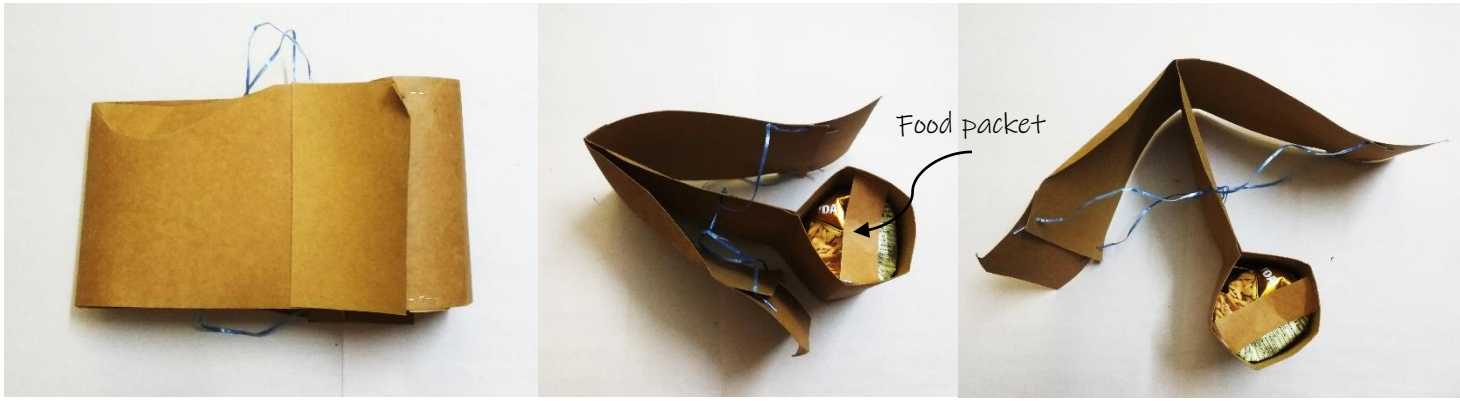
Ideations & Mock ups







Mock up model



CONCEPT 6

The Tumbling Drumstick seed


Fig. 6

The seed dispersal strategy in drumstick makes the seed fall out of naturally dried and cracked drumstick, allowing the seed to tumble on air currents with the help three fins grown on the triangular seed body.

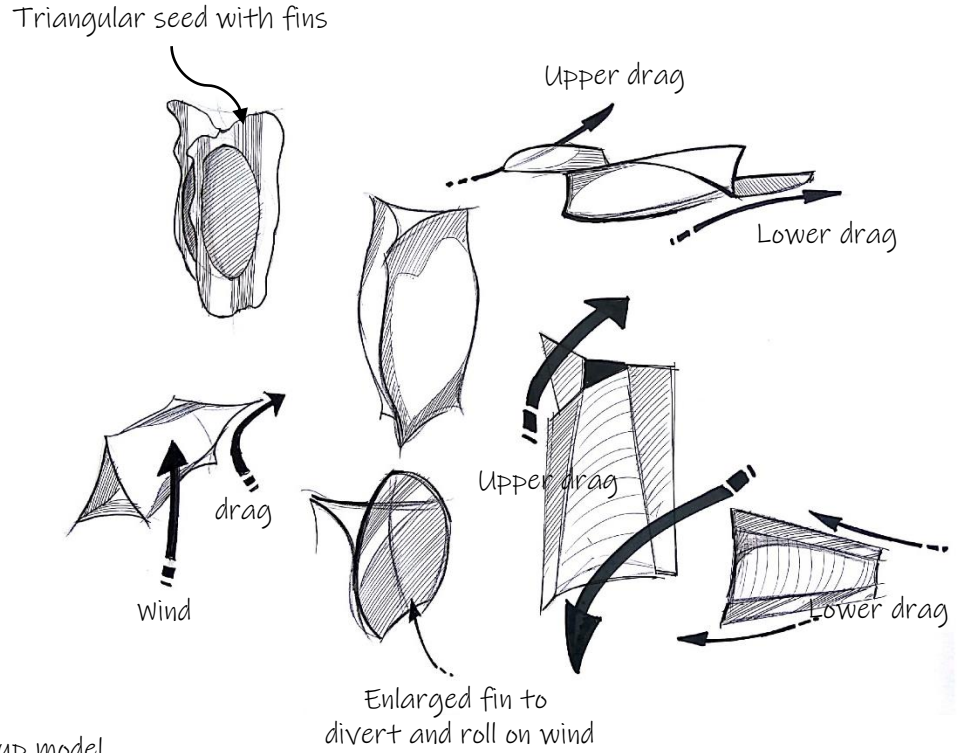
The idea was to make use of this aerodynamic quality in these seeds which is achieved out of growing fins.

Result from drop test:

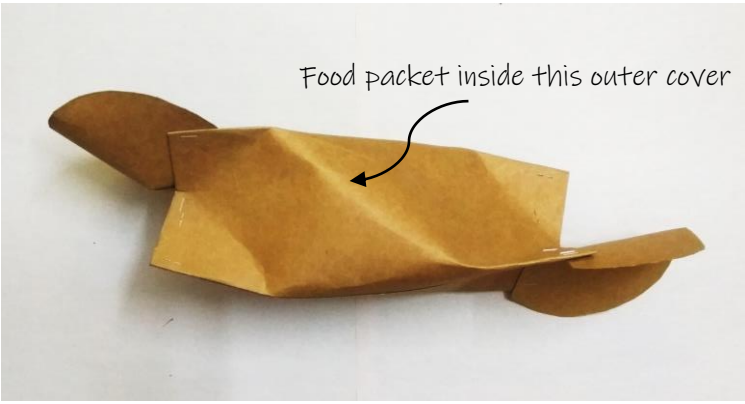
Time of drop from 20 m high- 5.33 sec

This design showed a good turning advantage for closer dispersal in an almost straight line drop.

Ideations & Mock ups



Mock up model



CONCEPT 7

The Flight of Barn Owl

Fig. 7

Not fastest but, one of the most graceful flying birds of the planet- The Barn Owl. It has the ability to create sufficient drag in a controlled manner such that, the wings creates minimum possible turbulence in the air. The wide wing spread and smaller body helps the owl to glide very smoothly and steadily even in low velocity winds. The idea was to make use of this steady gliding ability in low winds for better dispersal.

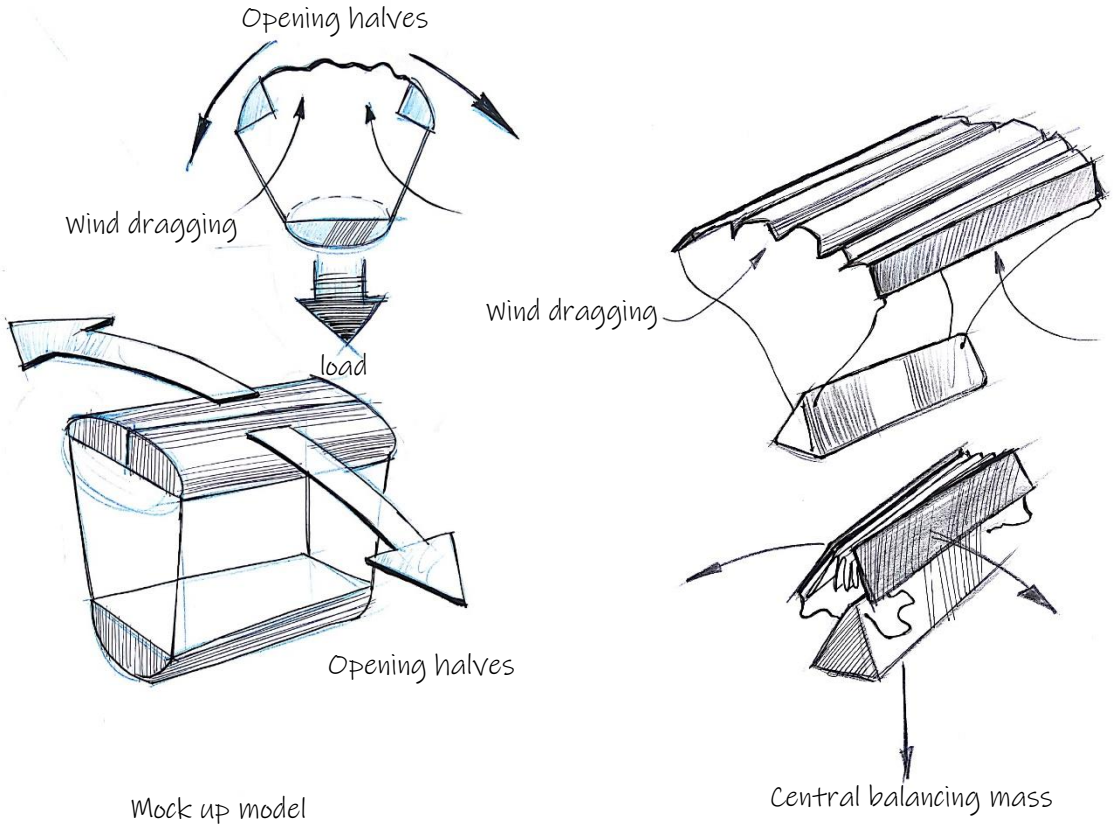
Result from drop test:

Time of drop from 20 m high- 8.98 secs

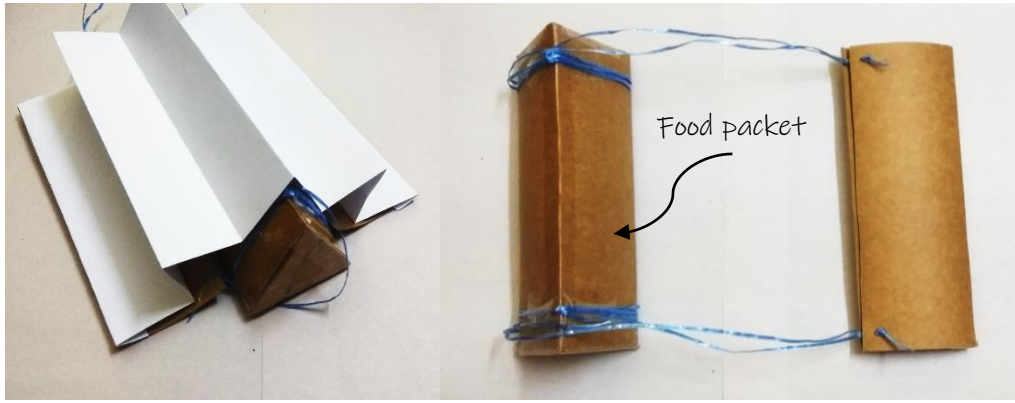
[Highest]

This design showed a wide spread and wind driven drop with achieving maximum time of flight for the process of dropping.

Ideations & Mock ups



Mock up model



CONCEPT 8

The Fall of Parijaatak

Fig. 8

The structure of petals in this flower helps the flower to drop gradually on the ground with the orange coloured stem balancing the mass centrally.

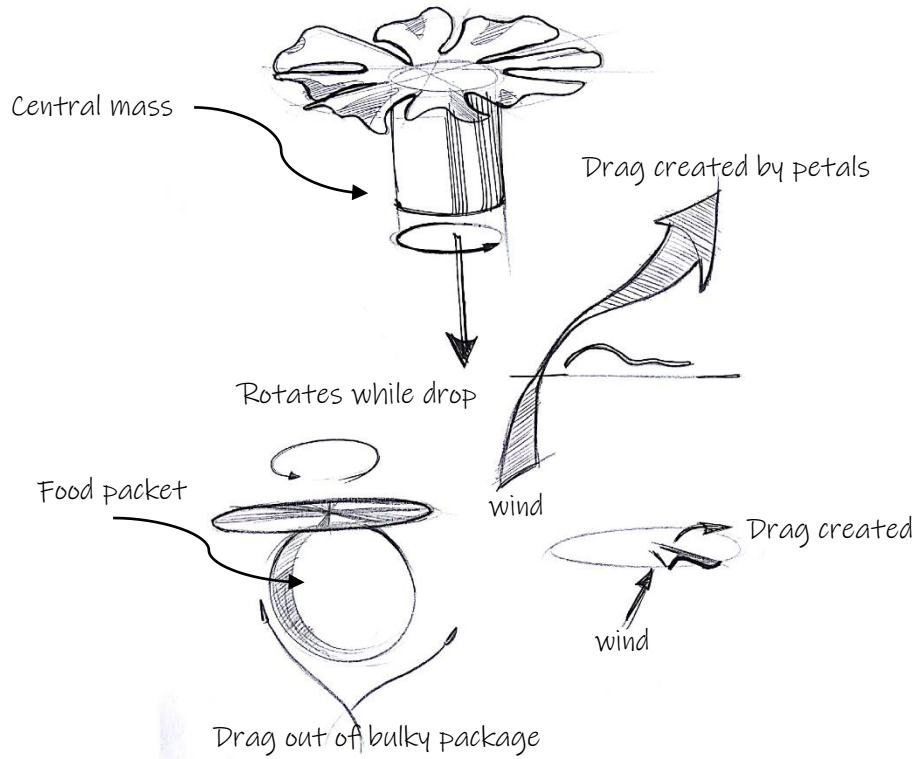
The idea was to replicate the peripheral form on the petals to achieve a gradual drop.

Result from drop test:

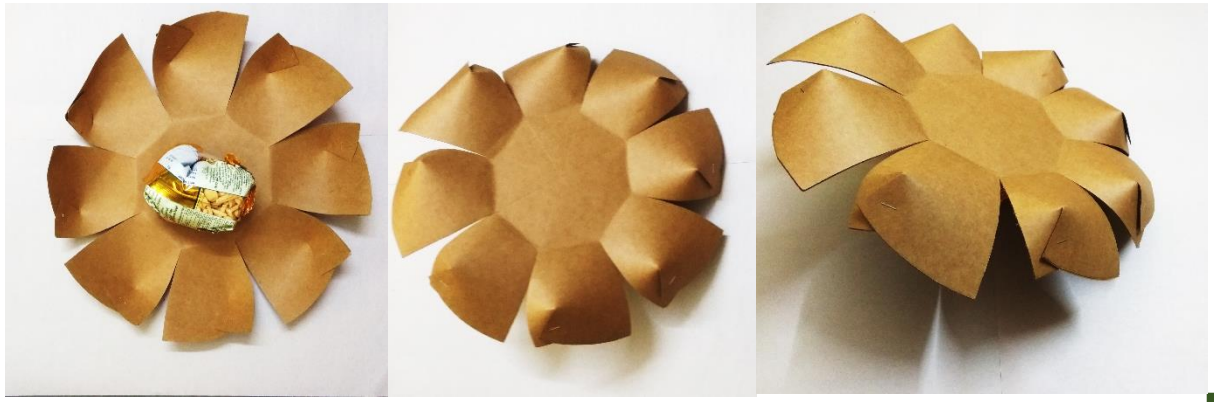
Time of drop from 20 m high- 6.63 sec

This design showed a very gradually and smooth drop with mild rotation that adds playfulness to the whole process of dropping.

Ideations & Mock ups



Mock up model



CONCLUSION

Considering the specified design considerations and the results from drop test (with a dead load of 50 g dropped from 20 m of height), the most suitable & optimally functional concept was found to be the Maple seed inspired-Concept 4.

The material used for the manufacturing this packaging would be Box-Board Paper [210 GSM], which is popularly used in packaging industry. The air tight food packet should be adhered to this dispersal packaging. The air tight packet can be a plastic or a boxboard paper with PVC Coating on it.

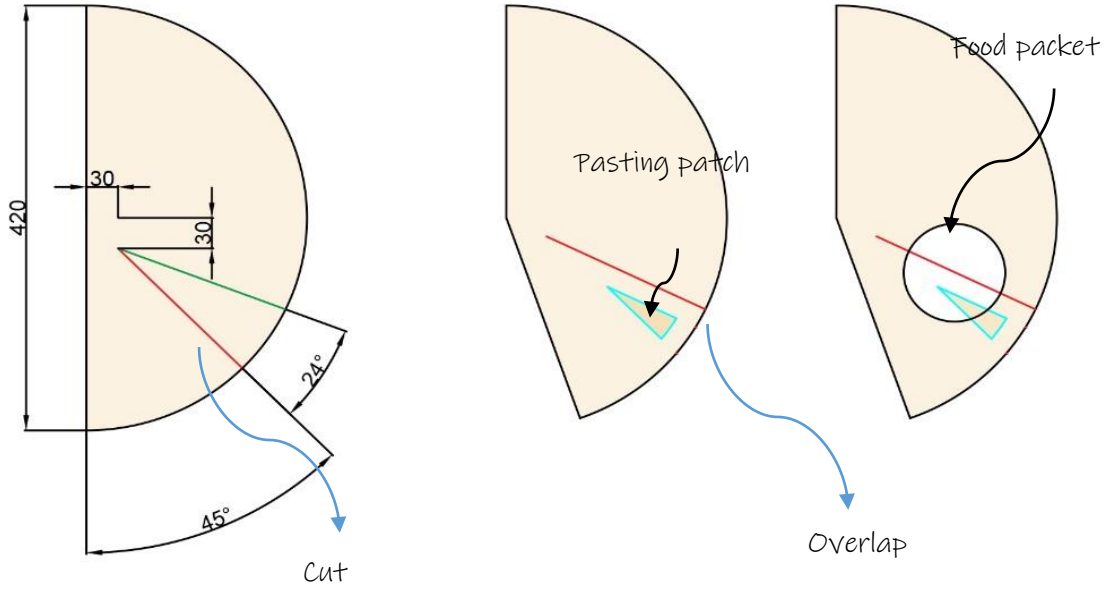
The air-tightness would facilitate the floating of the packet in case it falls in water & the water proof packet would protect food from insects and moisture in the surrounding.

The packaging would be stacked parallel to each other in the box containing them. The box should be turned down from a open end to disperse the packaging.

The height of 20m and the weight of 50 g was chosen keeping in mind the efficacy of the present dropping methods.

Surface development

ALL DIMENSIONS ARE IN MM



The material used for the manufacturing this packaging would be Box-Board Paper [210 GSM], which is popularly used in packaging industry.

The manufacturing of the surface development for this packaging would consist two simple following operations:

-One blanking operation

-Two pasting operation

REFERENCES

IMAGES

Fig.1- https://in.pinterest.com/pin/499336677414490021/ dated 1/2/2019

Fig.2- https://in.pinterest.com/pin/317644579955348312/ dared 1/2/2019

Fig.3- https://in.pinterest.com/pin/499336677414490021/ dated 1/2/2019

Fig.4- https://in.pinterest.com/pin/560698222350269066/ dated 3/2/2019

Fig.5- https://i.pinimg.com/originals/1f/d9/2e/1fd92ea65ffa473c356249a546d9e376.jpg dated 3/2/2019

Fig.6- https://in.pinterest.com/pin/396950154628044152/ dated 3/2/2019

Fig.7- https://in.pinterest.com/pin/480759328952493519/ dated 4/2/2019

Fig.8- https://in.pinterest.com/pin/491596115548475200/ dated 4/2/2019

WEB

1. *https://www.youtube.com/watch?v=xY4JFOSuqvY dated 1/2/2019*
2. *https://www.youtube.com/watch?v=-Ukk07JH4qI dated 1/2/2019*
3. *https://www.youtube.com/watch?v=OyuAt-_Nj_o dated 31/1/2019*
4. *https://www.youtube.com/watch?v=BxQMZVyZs0I dated 31/1/2019*
5. *https://www.youtube.com/watch?v=aqDber2inSY dated 28/1/2019*
6. *https://www.youtube.com/watch?v=d_FEaFgJyfA dated 28/1/2019*
7. *https://www2.palomar.edu/users/warmstrong/plfeb99.htm 27/1/2019*

VIDEOGRAPHY

https://drive.google.com/drive/folders/1uoeSO8qBKqBTGW7C5X6N6gJ7jsoWj8q0?usp=sharing

REVIEWS

REVIEW 1

PAPER: 4
TITLE: Nature inspired food dispersal Packaging Design for Flood Calamity
AUTHORS: Rajat Patle

*---------- **Summary** ----------*
The author has submitted his project report on the proposed design solutions for a 'food dispersal packaging'. Bio-mimicry of solutions found in nature have been used as analogies.

*---------- **Positive aspects** ----------*
It is not possible to review this submission as it is a project report and not a paper with any definite understanding of literature review, research methods or analysis.

*---------- **Negative aspects and improvements** ----------*
The author should be requested to write a paper and not submit a design project.

REVIEW 2

PAPER: 4
TITLE: Nature inspired food dispersal Packaging Design for Flood Calamity
AUTHORS: Rajat Patle

---------- ***Summary*** ----------
Food dispersal packaging for flood calamity

The current study identified a issue on food disposal during flood calamity. During design process, the study inspired from bio-mimicry of the plant and animal kingdom. Researcher minutely observed the way of dispersion of seeds/spores and did mockup testing of different plant as well as gliding of different animal/insect (eg Owl, Beetle). During mockup study, researcher measured the duration (second) for falling the food particle (weight 50g) for a standard height (20m). From the mockup study, it concluded that, copter maple seed dispersion method found best.

---------- ***Positive aspects*** ----------
The researcher highlighted a burning issues. Not much work done in this field so far. The researcher did the bio-mimicry and mockup development part very nicely. Like to appreciate the effort done by the researcher.

---------- ***Negative aspects and improvements*** ----------
Rather to call negative aspect, I will say below mentioned improvements can be carried out -

Sufficient documents that justify the research question. (how S/he came to know the current food dispersal methods are problematic? Current package size, weight, packaging material etc)
Justification of height (2om) and weight (50g) taken during mockup testing? Is it true representative of actual food dispersal methods? In first line mentioned about big and bulky package. In conclusion it is not mentioned what will be standard size and weight of package.
In problem section, mentioned about high impact, in conclusion doesn't mentioned about impact. It can be assumed that, taking more time means reduced the impact. what is the relation between time and impact? Please conclude properly.
For mockup used box-board paper, but what will be actual packaging material? (will be water resistance?)
Assumed it was pilot study. therefore some future scope should be included.
The packet with food will be float on water? From height it is not possible to drop in exact point. It can fall down on water also?
Please keep consistency when you are putting the number (eg. Concept 7, time 8.980, decimal point up to three digit but in other cases two digit)

REVIEW 3

PAPER: 4
TITLE: Nature inspired food dispersal Packaging Design for Flood Calamity
AUTHORS: Rajat Patle

---------- ***Summary*** ----------
This project is about designing a packaging using bionics

---------- ***Positive aspects*** ----------
An excellent project has all of the components of idea generation and selection of the final concept

---------- ***Negative aspects and improvements*** ----------
No research argument and no analysis of the argument

REVIEW 4

PAPER: 4
TITLE: Nature inspired food dispersal Packaging Design for Flood Calamity
AUTHORS: Rajat Patle

---------- ***Summary*** ----------
Authors plan to use mechanisms of biomimicry to disperse food during disasters such as floods to minimize wastage of food. Author took inspiration from bougainvillea flowers, spinning fruit of Thailand, black beetle, copter maple seed, mushrooms, drumstick seeds, barn owls, and Parijaatak flowers to construct various designs. Authors seem to have conducted "drop" experiments for each design with a load of 50g, and show results in terms of time taken by the design to reach the ground from a height of 20m. Authors claim that the design based on the maple seed is the "most suitable and optimally functional".

---------- ***Positive aspects*** ----------
I think the topic is very important and relevant for DRS. I also like the exploration that the authors have done with various forms.

---------- ***Negative aspects and improvements*** ----------
The current submission leaves much to be desired. I suggest that authors clearly establish their motivation behind this research. What is particularly missing are the goals of the experiment. Why is the drop time with a 50g load the best way to evaluate these designs? Why not look at different load factors? Why not the longevity of the package once it has landed under different conditions (e.g. wet, dry, hot, cold etc.)? Why not ability of the package to protect the food from insects or animals?
Secondly, authors should explain what has already been done in this space – the related work.
Thirdly, authors should clearly explain the method used (assuming that they are still sticking to the current experiment). In the current report, I could not tell how many trials were done, and how the conditions were maintained? For example, it is possible that there was a strong wind or an upward draft when you tested the winning design, and such conditions were absent when the other designs were tested. Why was a height of 20m chosen? How the "drop from a helicopter" was simulated? Etc.
Fourthly, all results should be pulled together and compared, including mean times, standard deviations, and number of trials in each case. The authors should also report 95% confidence intervals, and if possible a statistical test to compare the winning design with others. (These are now part of the MDes curriculum).
Finally, authors should write a detailed conclusion, including the main findings, the claims, the implications of these claims and future research.
I will end this review by stating that if all the above is done, this work could be potentially published in a design conference. But a lot still needs to be done first.