Technische Universität Berlin
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Modeling Civil Engineered Systems

Individual Assignment II – Parametric Modeling

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1. Introduction

Rooftop helipads are essential infrastructure for emergency medical services, high-rise buildings, and offshore facilities. Their design involves balancing multiple engineering constraints, including safety, structural load limits, and geometric regulations set by aviation authorities.

Parametric modeling provides a powerful way to explore such competing demands by allowing designers to quickly generate, modify, and evaluate alternative configurations based on input parameters. This supports effective decision-making, optimization, and documentation of engineering rationale.

This project presents a parametric model of an Aluminum Rooftop Helipad built using Dynamo for Revit 2026, with automated generation of deck geometry, supporting columns, beams, and safety rings. The model computes structural volumes and weight and supports systematic variation of deck diameter, enabling exploration of performance trade-offs.

2. Design Challenge

The chosen design challenge is "Balancing structural weight and aviation safety clearance requirements in rooftop helipad design."
This challenge exists because:

- Larger helicopters require larger landing areas (safety requirement).
- Larger deck diameters increase column height, beam length, and overall structural weight.
- Rooftop structures can carry limited loads due to the building's capacity.
- Aviation guidelines (ICAO & FAA) mandate minimum space depending on helicopter size.

Thus, deck diameter is a critical parameter, and adjusting it triggers full structural reconfiguration.

3. High-Performance Criteria

This project evaluates the helipad using two engineering criteria:

Criterion 1 — Structural Weight (Minimize)

A lighter structure reduces load on the building roof, reinforcement requirements, and cost. The model computes total structural volume and weight of deck slab, columns, perimeter beams, radial beams and safety net. Density of aluminum is applied to calculate total mass.

Criterion 2 — Safety Radius (Meet Aviation Standards)

Aviation rules:

- ICAO: FATO ≥ Rotor Diameter
- FAA: Touchdown Safety Area ≥ 1.5 × Maximum Helicopter Dimension

Therefore:

- Small helicopters → smaller deck (lower weight)
- Medium helicopters → medium deck
- Large helicopters → larger deck (higher safety margin, but heavier)

4. Parametric Model Description

The Dynamo model is organized into grouped modules corresponding to logical components of the helipad. All geometry updates automatically based on user-defined parameters.

4.1 Input Parameters

User-controlled sliders include:

- Deck Diameter
- Column Height
- Beam Width & Depth
- Safety Ring Offsets
- Material Density (Aluminum)
- Structural Thickness

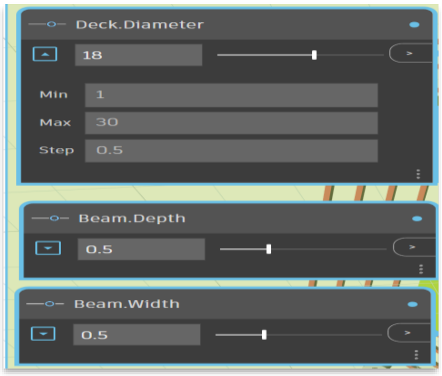

Figure 1: Input Parameters

4.2 Geometric Embodiment

Deck Geometry:

- Octagonal deck generated from angle-based vertices.
- Slab created via upward extrusion.

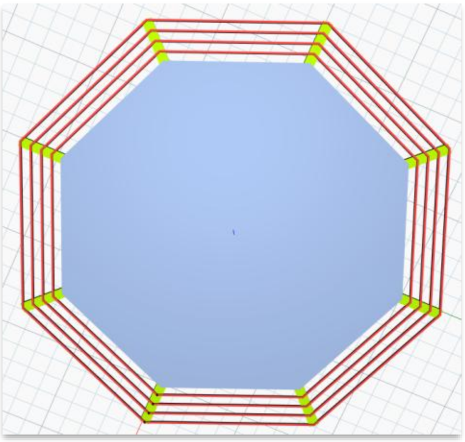

Figure 2: Helipad Deck (Octagonal)

Columns:

- Eight corner columns + central column.
- Solids are created using *Cylinder.ByPointsRadius* or equivalent.
- Heights controlled parametrically.

Radial Beams:

- Eight beams connecting center to corner columns.
- Extended by +2.5 m outward to support safety rings.
- Created using *Curve.ExtrudeAsSolid*, oriented along local beam axes.

Perimeter Beams:

- Aligned with octagon edges, with local CS orientation.
- Rectangular profiles aligned to tangent and perpendicular local axes.

Safety Rings:

- Four concentric octagonal rings at offsets of 0.5 m, 1.0 m, 1.5 m and 2 m.
- Created using PolyCurve.OffsetMany and extruded into solids using *ExtrudeAsSolid*.
- Rings sit on the radial beam extensions

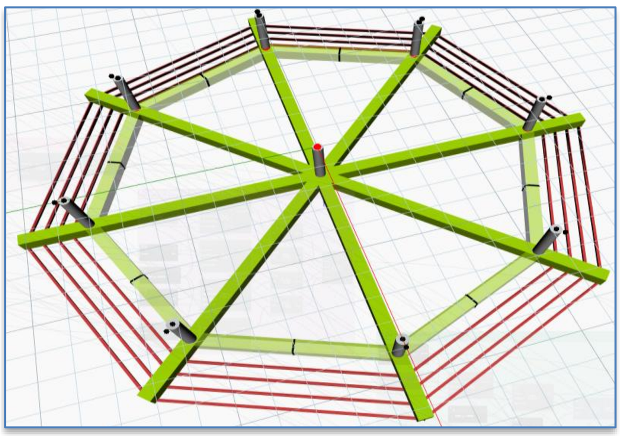

Figure 3: Bottom view showing Columns, Radial Beams, Perimeter Beams and Safety Rings

5. Structural Performance Evaluation

Volumes of all components are computed using *Solid.Volume* nodes. Total structural weight is computed using:

Weight = Volume × 2700 kg/m³.

6. Design Space Exploration (Three Variations)

Three alternatives were created by scaling deck diameter corresponding to helicopter categories.

Variation	Helicopter Category	Deck Diameter (m)	Safety Rating	Structural Weight (tons)
A	Light Helicopter (EC135)	14	Meets ICAO	182.6
B	Medium Helicopter (AW139)	20	High safety	310.5
C	Heavy Helicopter (S-92)	26	Max safety	472.82

7. Discussion

Variation A — Small Deck with 14 m dia

• Lowest structural weight; minimal roof reinforcement required; limited helicopter compatibility and suitable for light EMS helicopters.

Variation B — Medium Deck with 20 m dia

• Best balance between safety and weight; supports the most commonly used rescue helicopter sizes; Likely the most economical & practical design.

Variation C — Large Deck with 26 m dia

• Highest safety margin; supports heavy helicopters but significantly increases weight and structural demand.

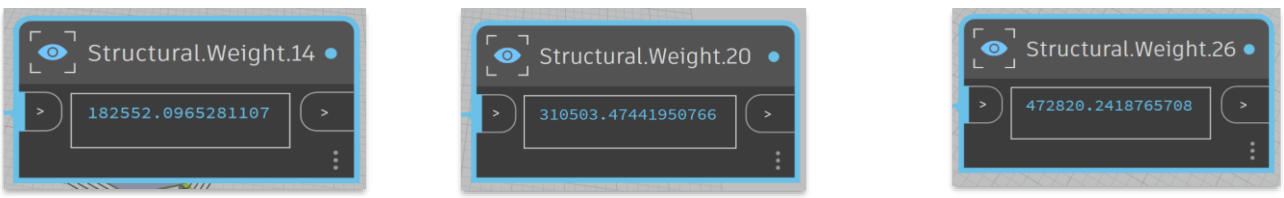

Figure 4: Structural weight of the helipad when diameter of the deck is varied (14m, 20m, 26m)

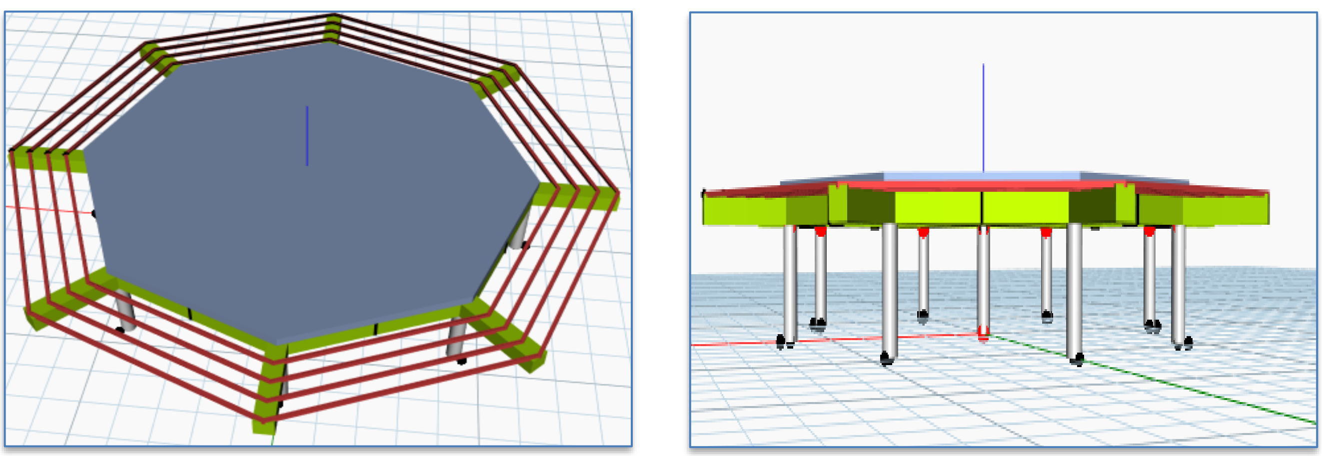

Figure 5: 3d view and Side view of the Aluminum Rooftop Helipad

8. Conclusion

The parametric model demonstrates a clear relationship between deck diameter, structural weight, and aviation safety compliance. Variation B provides the optimal engineering balance. It demonstrates clear engineering rationale, meaningful design space evaluation, structured parametric logic, and well-defined high-performance criteria.

9. References

ICAO Heliport Manual, International Civil Aviation Organization. Safety rules for FATO and TLOF diameters.

FAA Heliport Design Guide AC 150/5390-2C, Federal Aviation Administration. Touchdown safety area ≥ 1.5 × helicopter dimension.

NORSOK C-004. (2013). Helicopter Deck Design – Edition 2. Norwegian Petroleum Industry Standard

Fech Heliports. (2024). Rooftop Helistop Specification Sheet

Autodesk Dynamo BIM Documentation.

Assignment 1 Report – Helicopter rotor diameters & sizing rules.