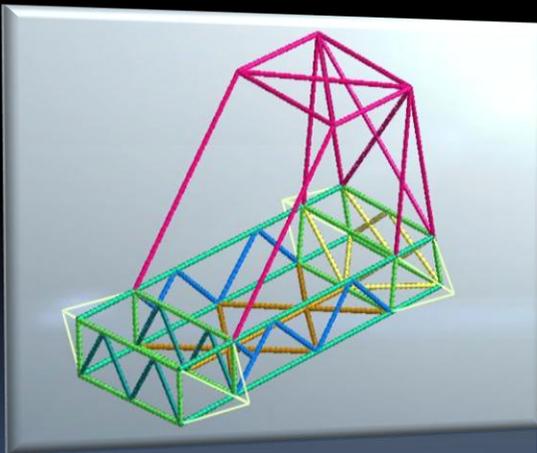


# BAJA FRAME DESIGN PROJECT



코카인(Co-Car人)  
2009009844 임성진  
2009009747 유건호

# 개요

1. Baja concept
2. 기본 frame
3. 위상 최적화
4. 치수 최적화
5. 결과

## Baja concept(1)

- 목표 : Baja 규격에 맞는 Body frame의 설계
- 고려사항 : 굽힘, 비틀림 강성  
고유진동수, 무게

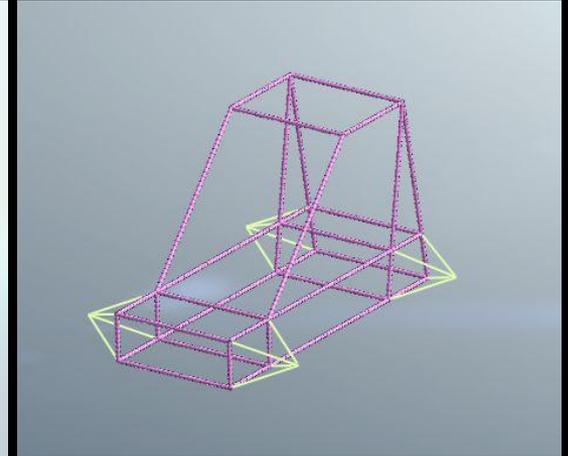
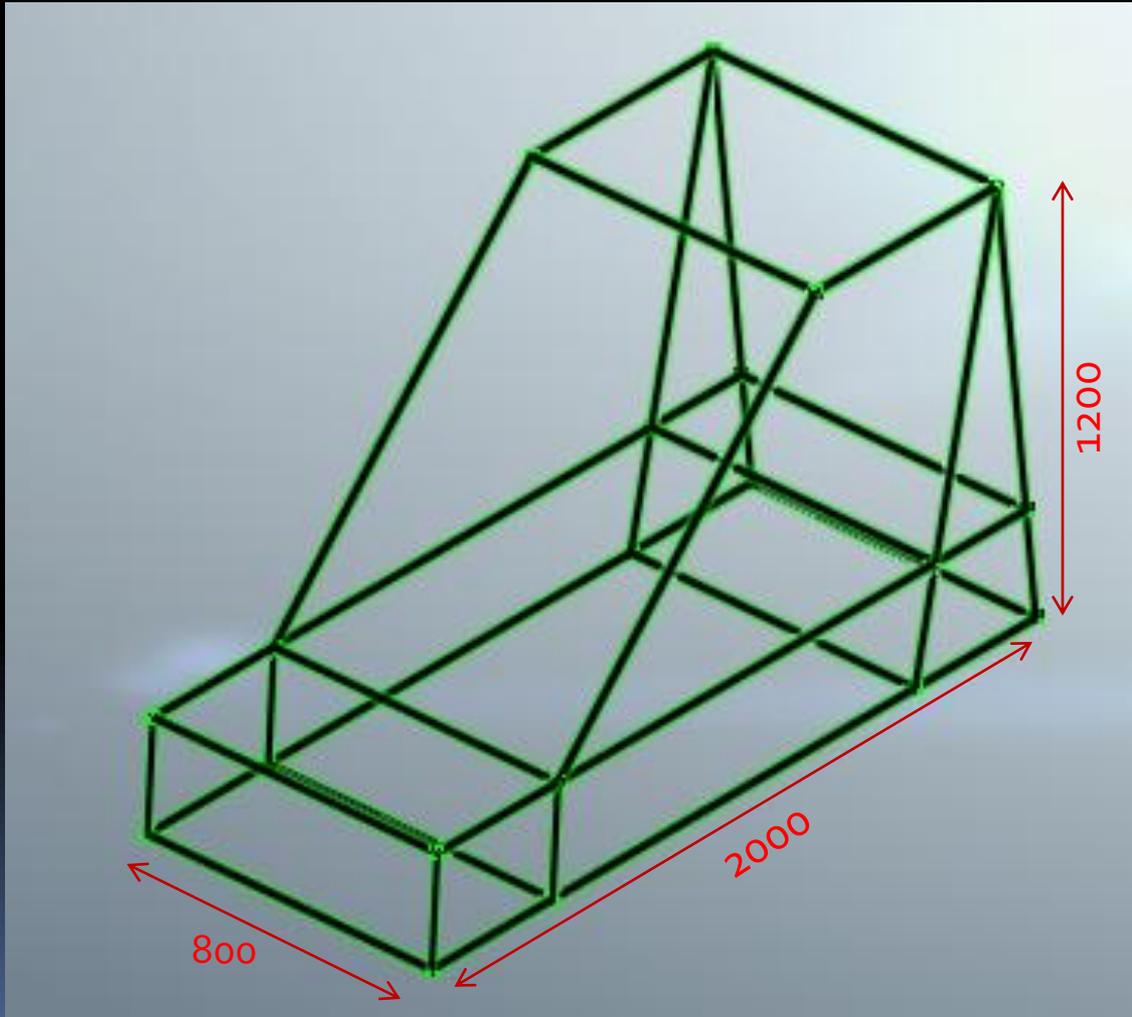
# Baja concept(2)



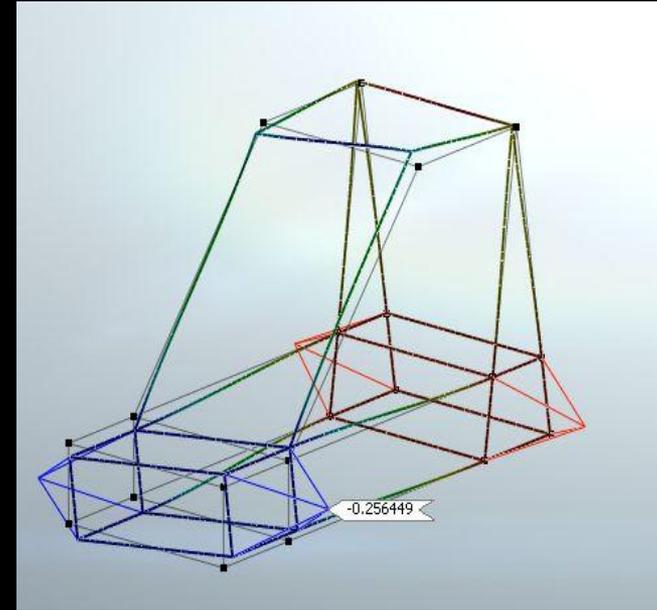
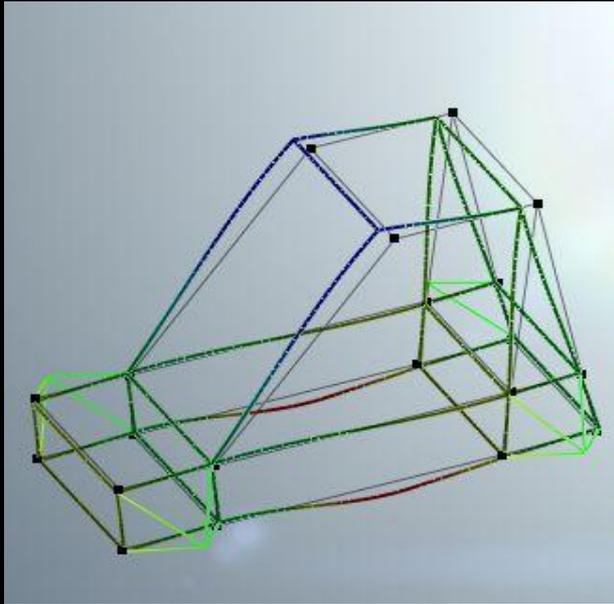
## Baja concept(3)

- 무게 (규정집 1장 2조 3항)
  - 연료 가득 채운 상태 **230kg 이상** (2300N)
  - 엔진부 1000N
  - 탑승부 700N
  - 기타 부속 300N
  - **>Frame 300N 이상!!(약 30kg)**
- 고유진동수
  - 엔진 회전속도 범위 0~3000rpm
  - 요구 고유진동수 **50Hz**이상

## 기본 프레임



## 기본 프레임 결과



질량	굽힘	비틀림	주파수
14.9 (kg)	2058.8 (N/mm)	23437.5 (Nm/rad)	11.7 (Hz)

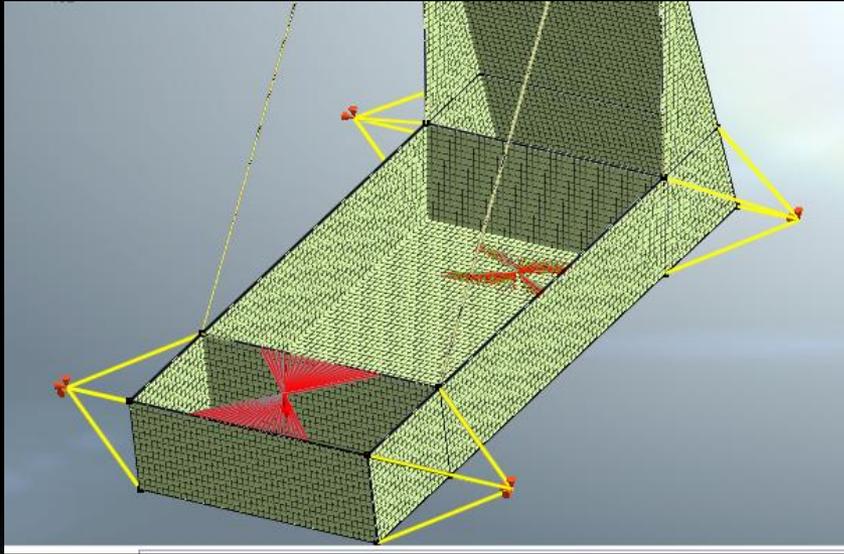
# 최적화문제 정식화

설계변수 : 유한요소의 밀도

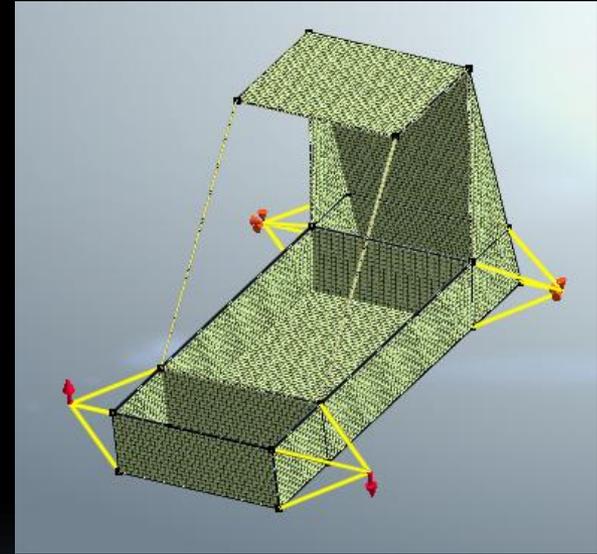
목적함수 : 컴플라이언스 최소화

구속조건 : 부피최소화,  
주파수  $> 25\text{Hz}$

## 위상 최적화 조건

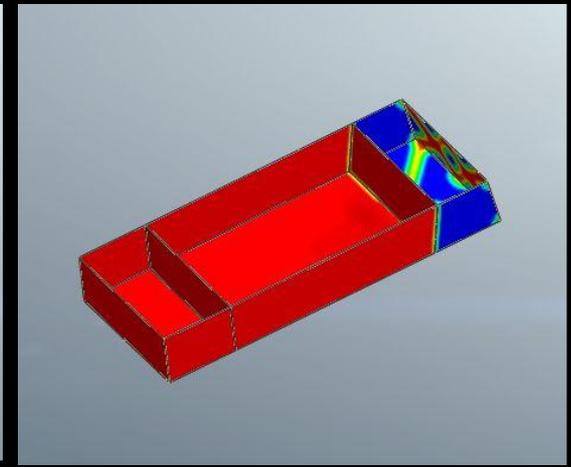
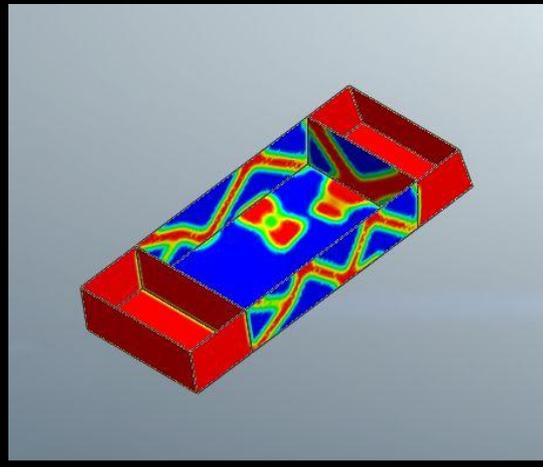
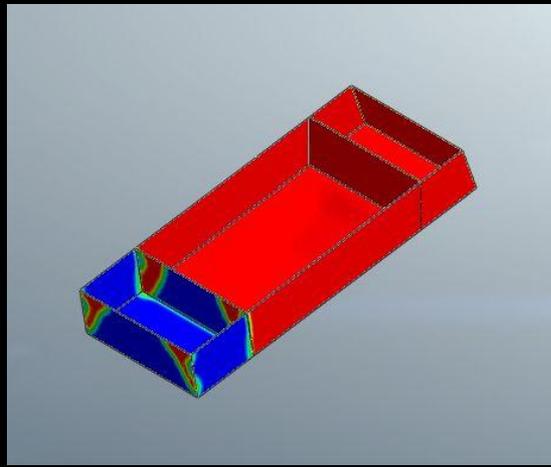
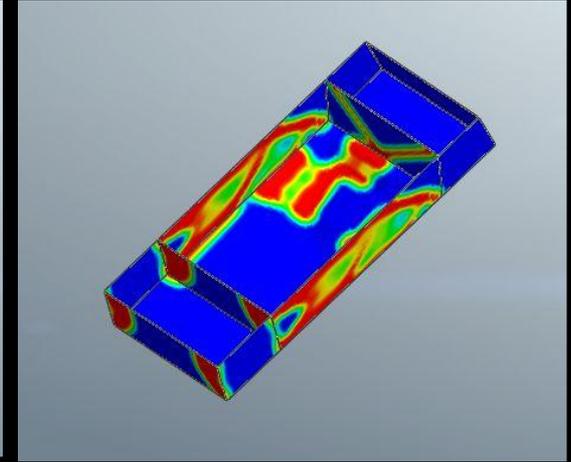
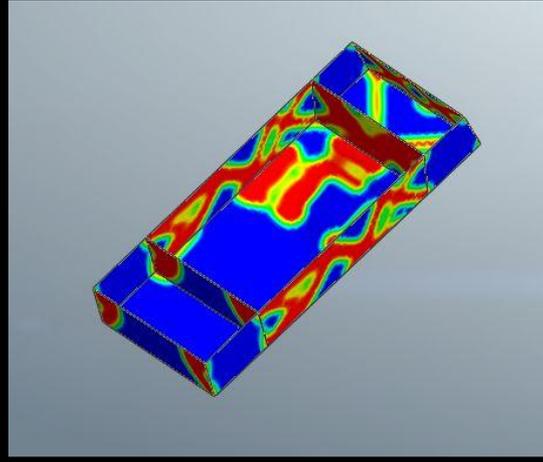
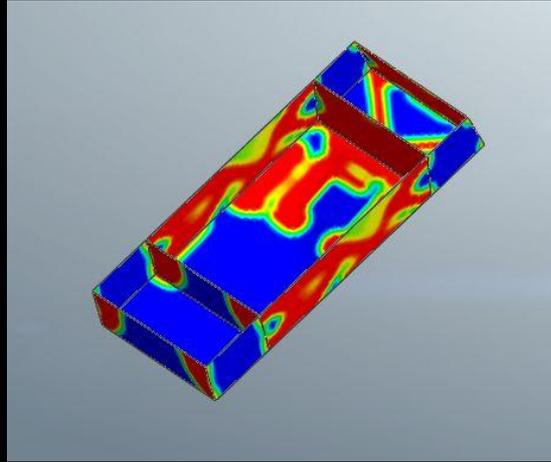


하중 조건

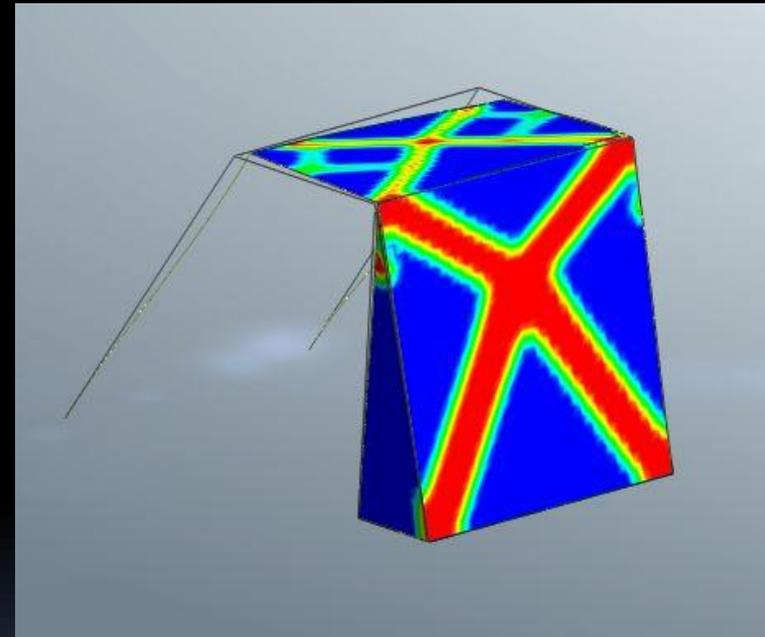
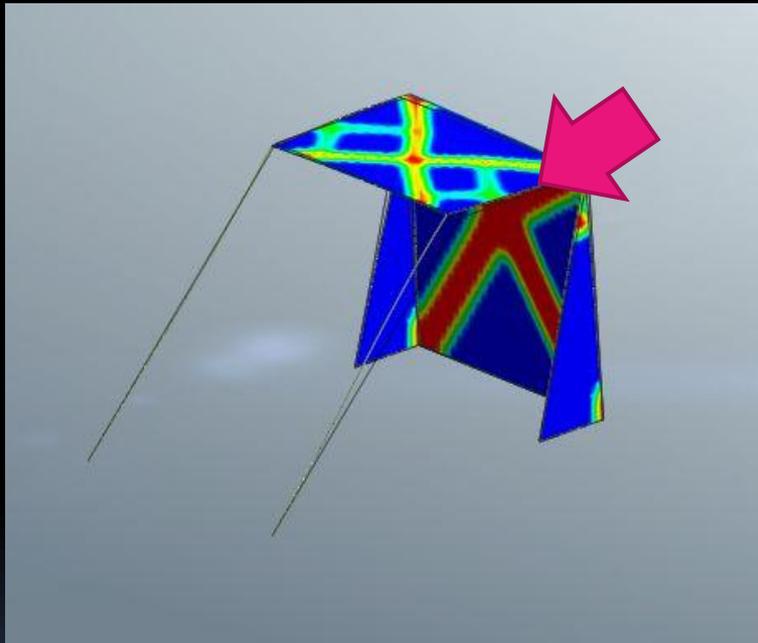


비틀림 조건

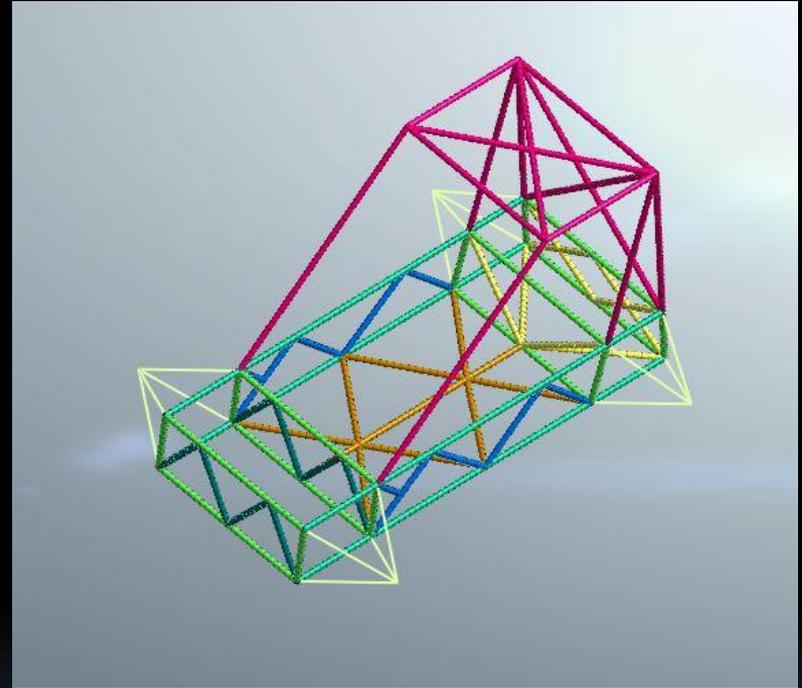
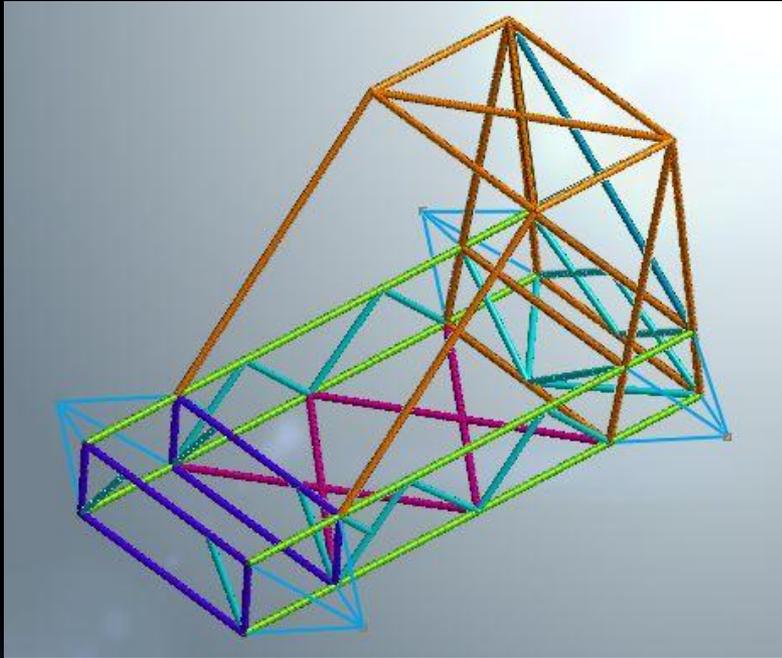
## Main Frame



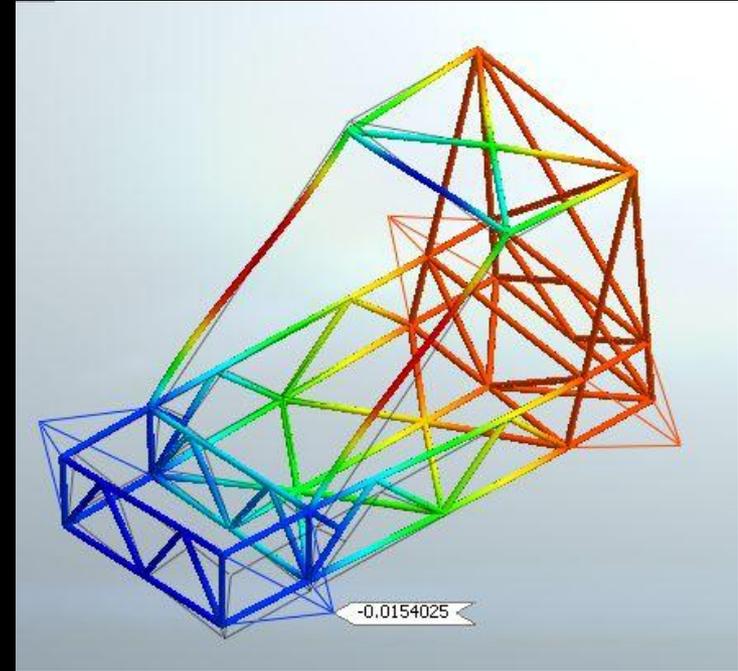
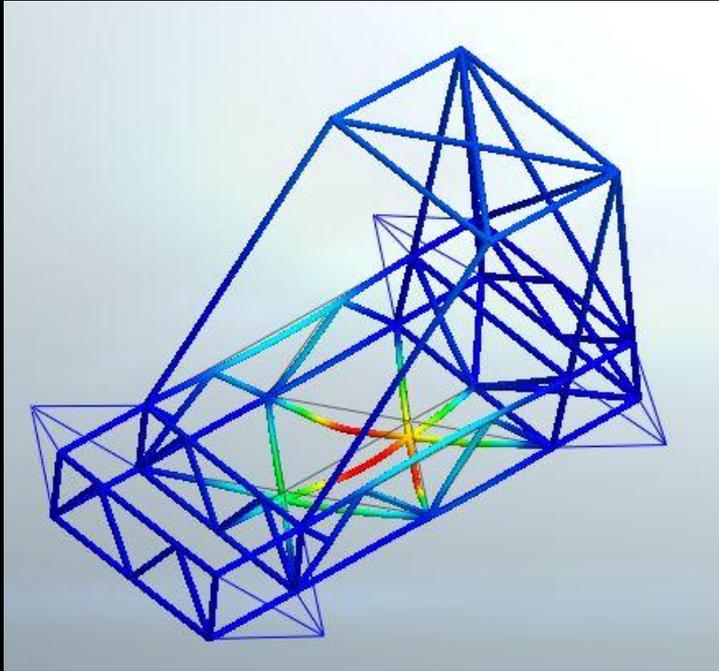
## Top Frame



## 위상최적화 모델

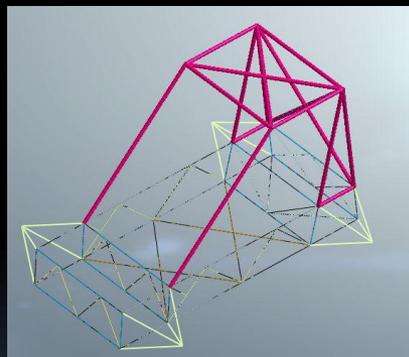
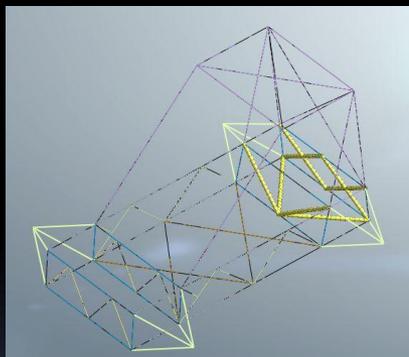
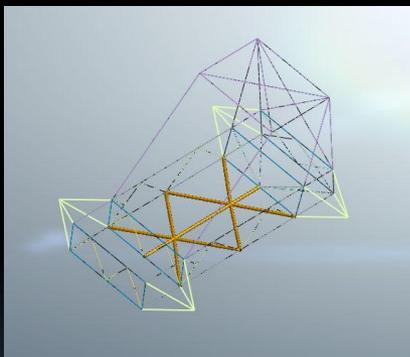
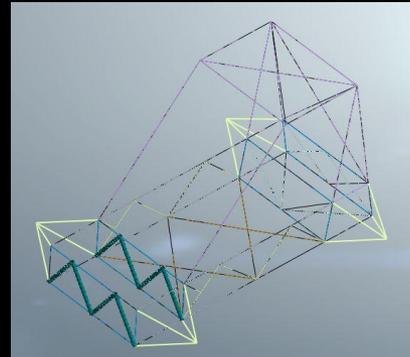
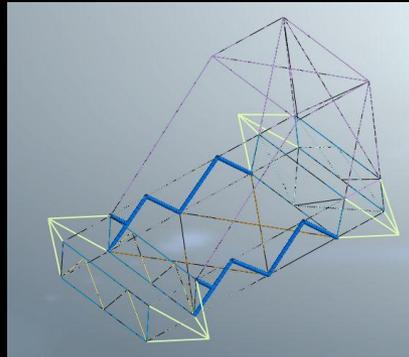
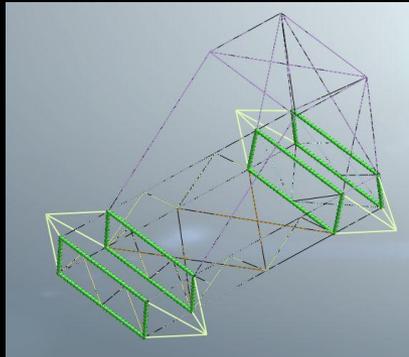
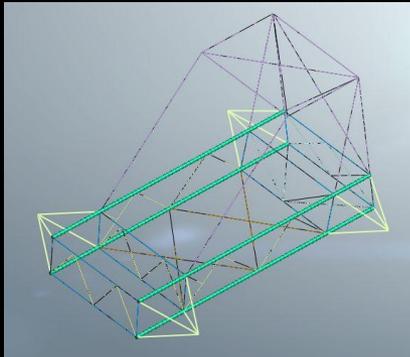


## 위상최적프레임 결과



질량	굽힘	비틀림	주파수
27.08 (kg)	2,800 (N/mm)	400,000 (Nm/rad)	71.2 (Hz)

## 치수최적화 조건

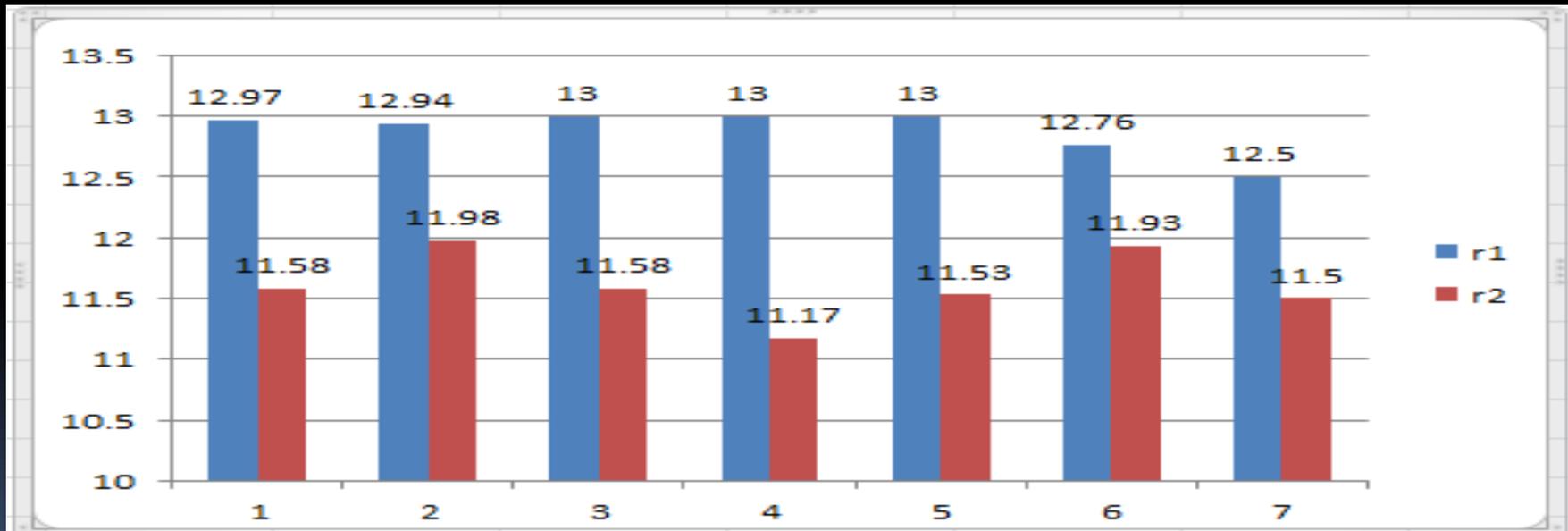


12~13mm

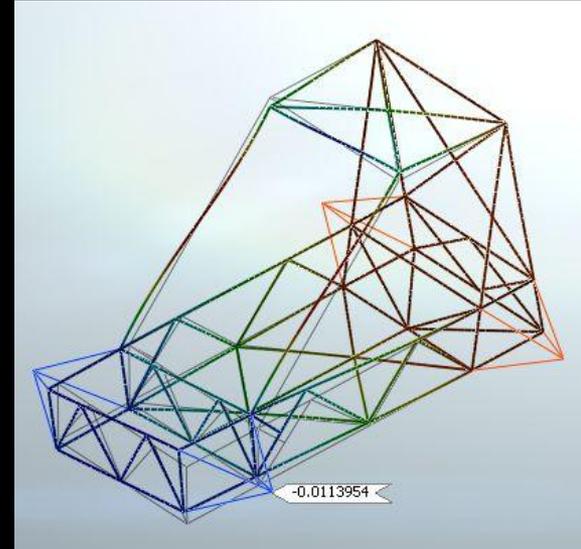
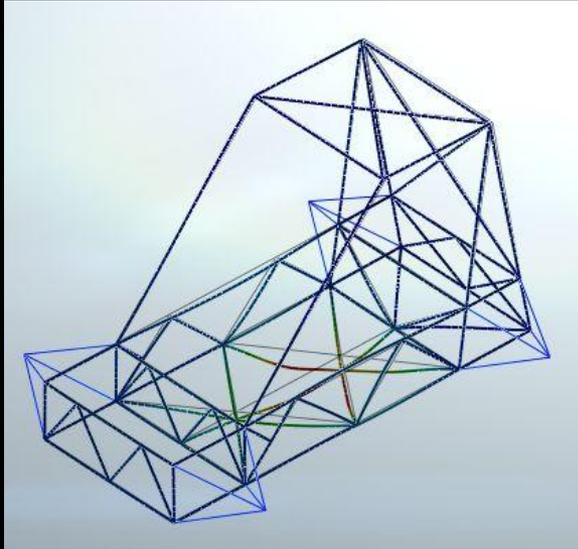
11~12mm

## 치수 최적화

목적함수 변화율 (%)	0				22		24		25		22	22
제약조건 최대위배율 (%)	88				1.6		2.4		22		1.6	17
부피	3.5e+006				4.3e+006		4.4e+006		4.4e+006		4.3e+006	4.3e+006
하중변위	0.38		0.1	0.2	0.098		0.098		0.078		0.098	0.23
비틀림변위	0.011		0.007	0.009	0.007		0.007		0.007		0.007	0.0085



## 치수최적화 결과



질량	굽힘	비틀림	주파수
32.99 (kg)	4,745 (N/mm)	545,454 (Nm/rad)	71.2 (Hz)

## 비교분석

	기본프레임	위상최적화	치수최적화
질량	14.9	27.08	32.99
굽힘	2058	2800	4745
비틀림	23437	400000	545454
주파수	11.7	71.2	71.2

Comparison of design optimization results for the Baja Frame Design Project. The table shows the performance of three optimization methods: Basic Frame, Topology Optimization, and Size Optimization.

Key observations from the comparison:

- Quality (질량):** Increases from 14.9 (Basic) to 27.08 (Topology) and 32.99 (Size).
- Bending (굽힘):** Increases from 2058 (Basic) to 2800 (Topology, +36%) and 4745 (Size, +69%).
- Torsion (비틀림):** Increases from 23437 (Basic) to 400000 (Topology, +1600%) and 545454 (Size, +36%).
- Frequency (주파수):** Increases from 11.7 (Basic) to 71.2 (Topology) and remains at 71.2 (Size).

# Q&A