위상 최적화를 이용한 굴삭기의 Arm과 Boom의 최적 설계

Team 프로세스
조용식, 신홍재

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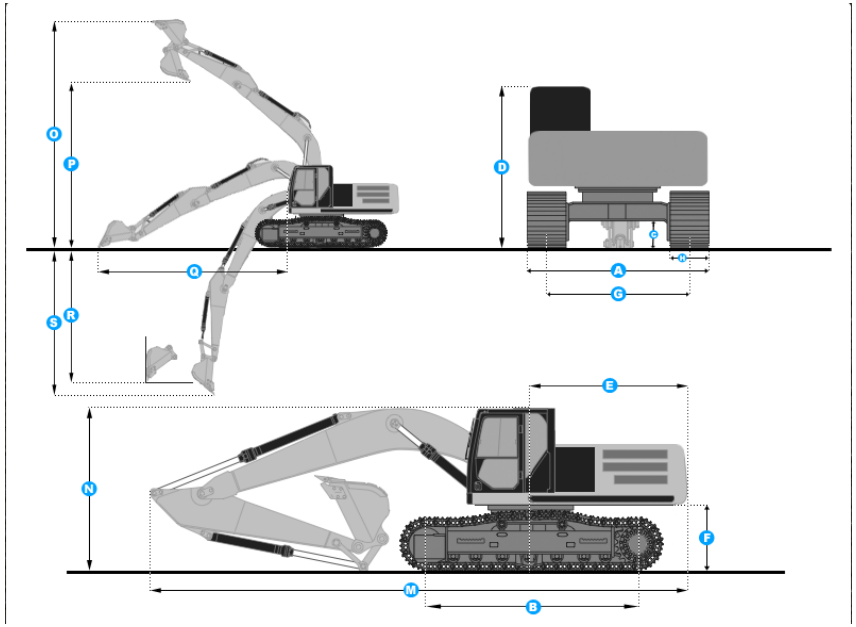
Background

Komatsu PC200-1

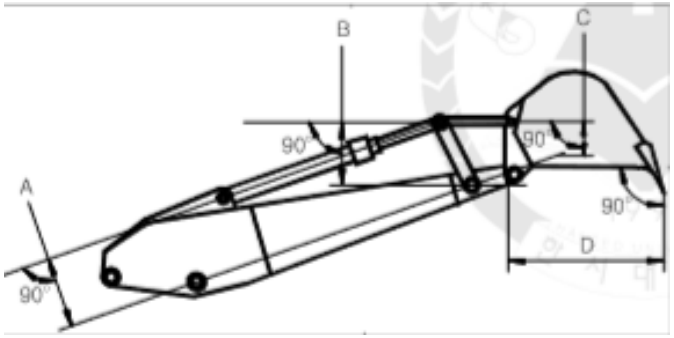
Background



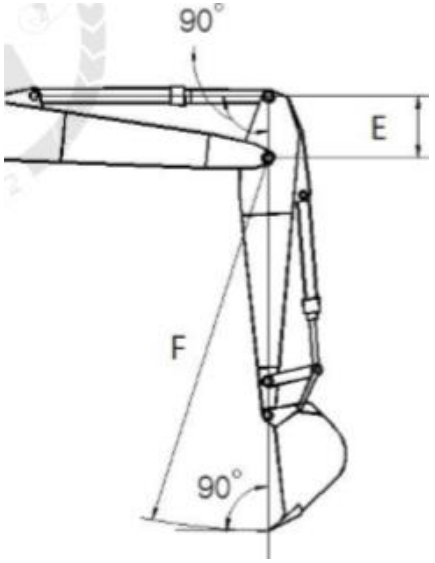
DIMENSIONS	
A: Width (Outside of Tracks)	9.1 ft in (2770 mm)
B: Length (Track on Ground)	10 ft in (3060 mm)
C: Ground Clearance	1.5 ft in (455 mm)
D: Height (Top of Cab)	9.4 ft in (2865 mm)
E: Tail Swing Radius	9.4 ft in (2860 mm)
G: Track Gauge	7.1 ft in (2160 mm)
H: Shoe Size	24 in (610 mm)

Hydraulic System Relief Pressure	3560 psi (24545.3 kPa)

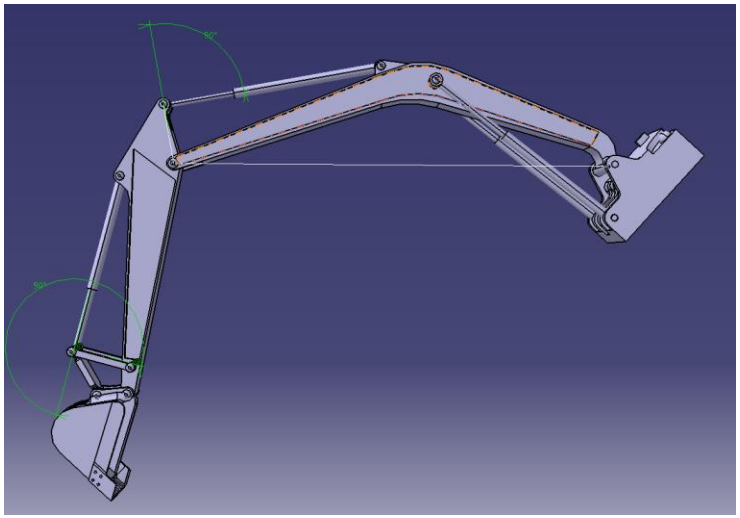
Background



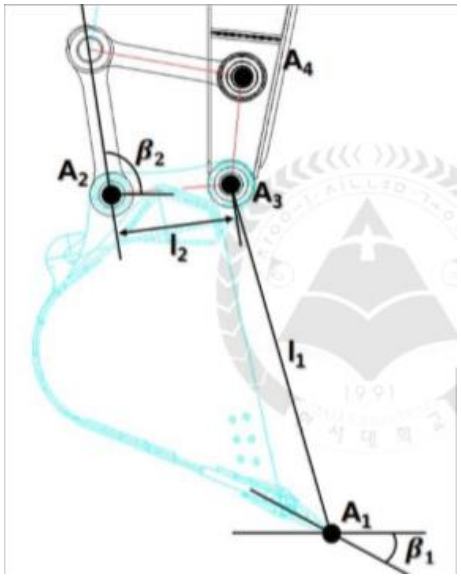
최대 버켓 굴삭력 자세

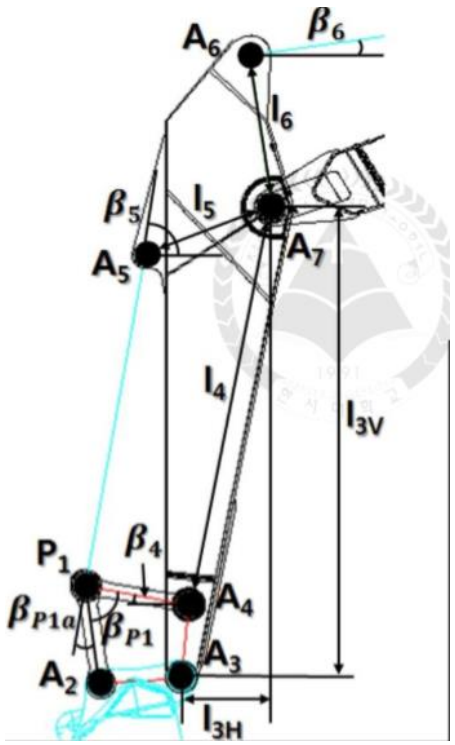


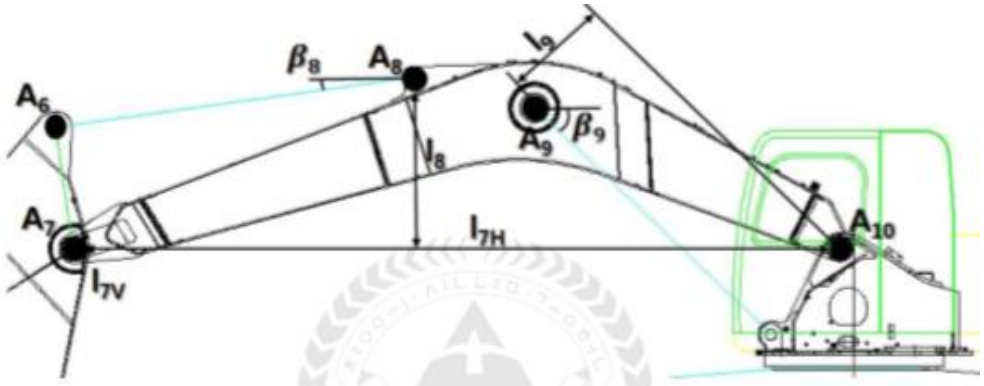
최대 암 굴삭력 자세



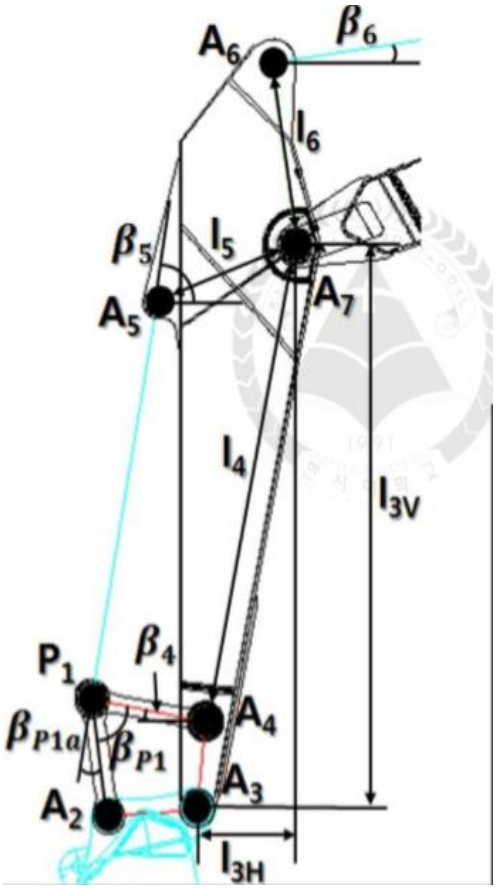
Numerical Model

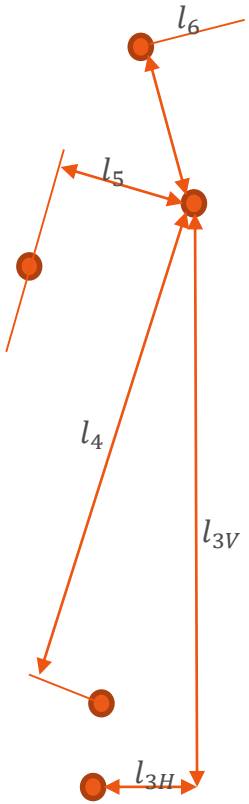






Numerical Model



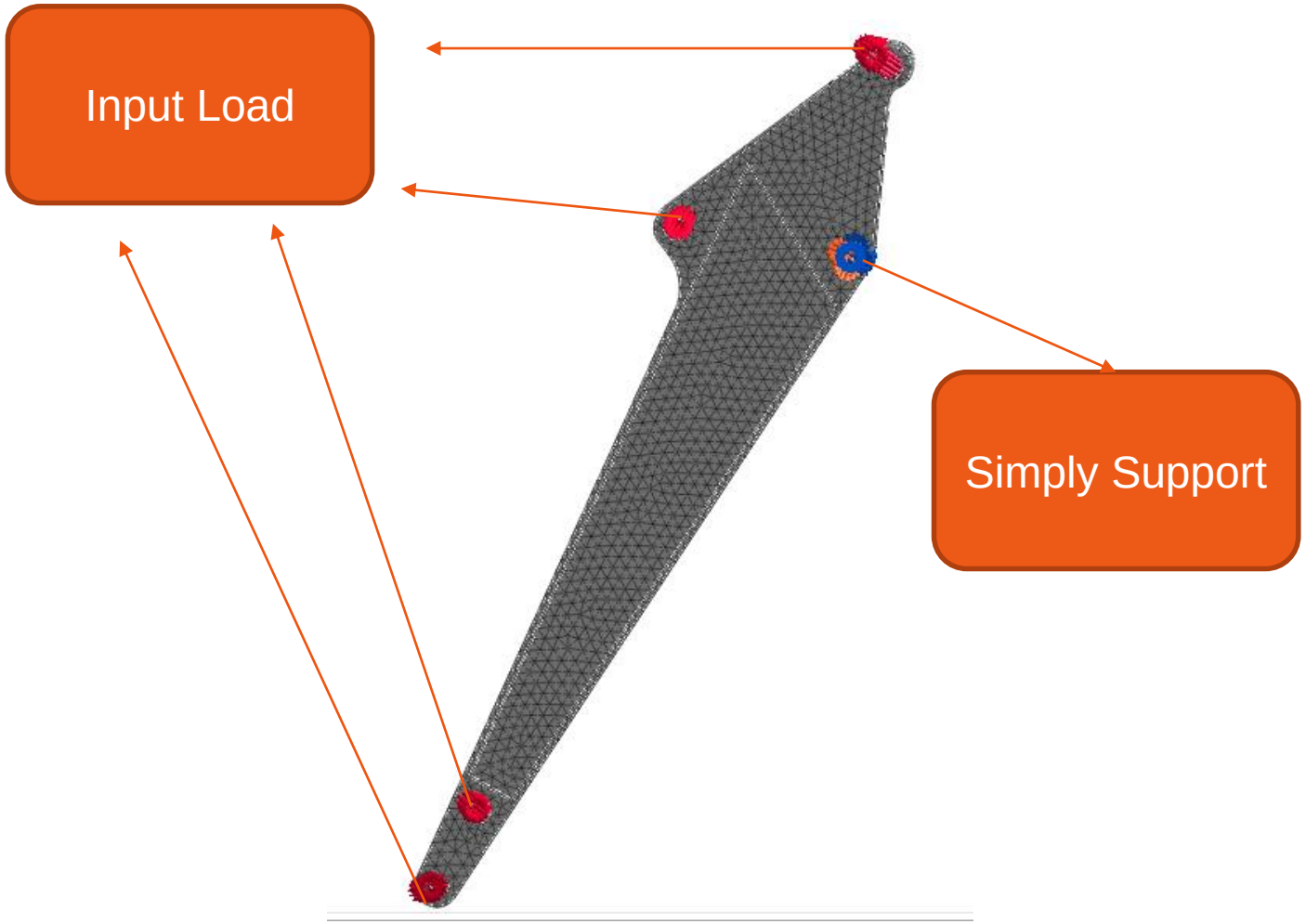


$$F_4 = F_2 \times \cos(\beta_{P1}),\ F_{4H} = F_4 \times \cos(\beta_4),\ F_{4V} = F_4 \times \sin(\beta_4)$$

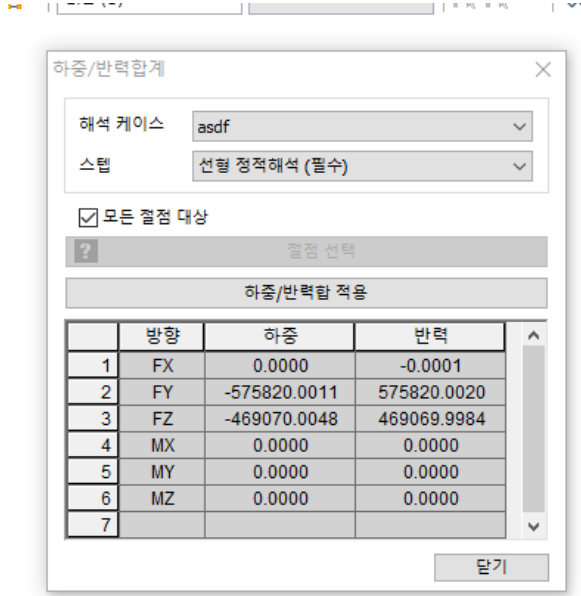
$$F_5 = F_2 \times \cos(\beta_{P1a}),\ F_{5H} = F_5 \times \cos(\beta_5),\ F_{5V} = F_5 \times \sin(\beta_5)$$

$$F_6 \times l_6 = (F_{3V} \times l_{3H}) + (F_{ga} \times l_{ga}) - (F_{3H} \times l_{3V}) - (F_4 \times l_4) - (F_5 \times l_5)$$

Numerical Model

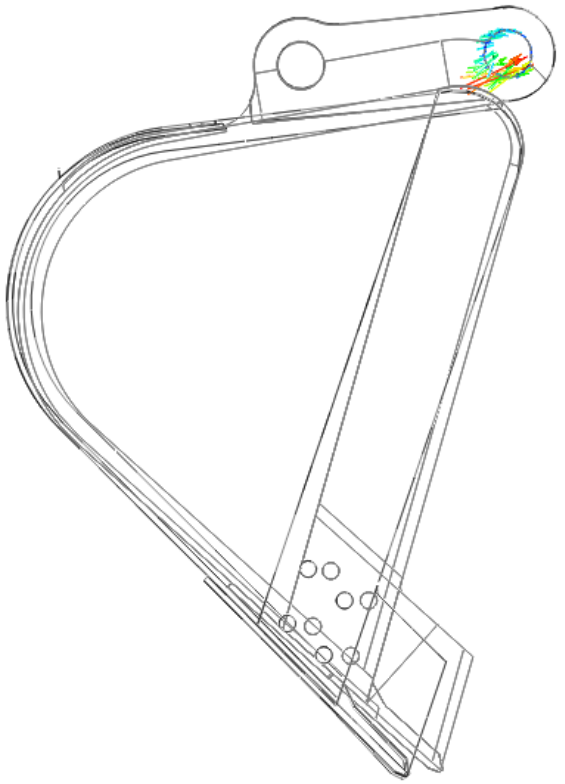


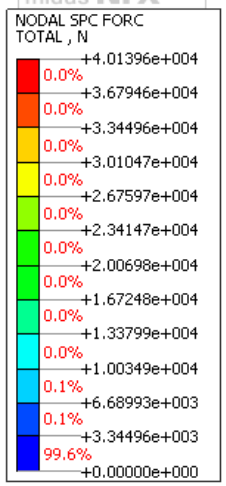
Numerical Model

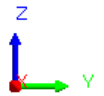


A3H -575820

A3V -469070







Numerical Model

하중/반력합계

해석 케이스 ASD

스텝 선형 정적해석 (필수)

☑ 모든 절점 대상

? 절점 선택

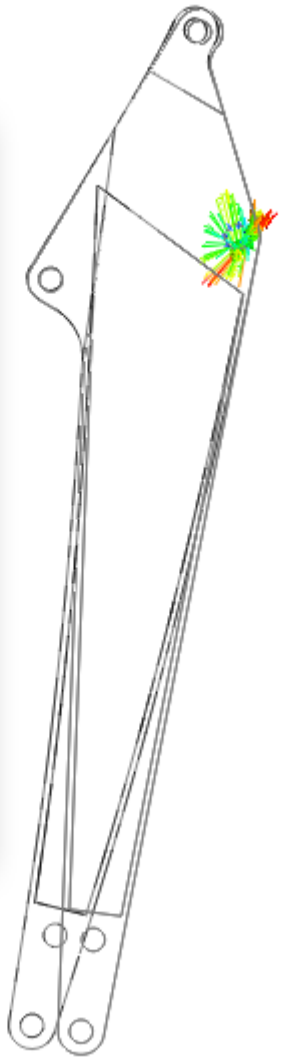
하중/반력합 적용

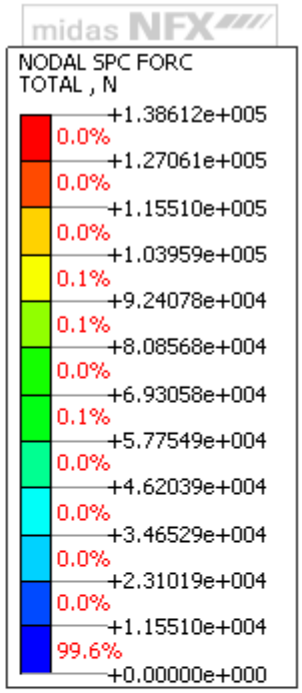
	방향	하중	반력
1	FX	0.0000	-0.0077
2	FY	-4984489.9805	4984490.0035
3	FZ	923350.0120	-923350.0198
4	MX	0.0000	0.0000
5	MY	0.0000	0.0000
6	MZ	0.0000	0.0000
7			

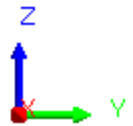
닫기

A7H -4984500

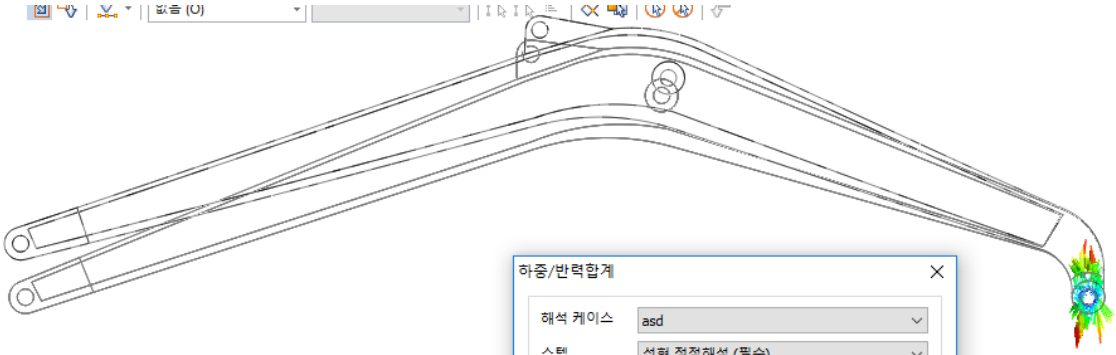
A7V 923350







Numerical Model



midas NFX

NODAL SPC FORC
TOTAL , N

0.0%	+4.79676e+006
0.0%	+4.39703e+006
0.0%	+3.99730e+006
0.0%	+3.59757e+006
0.0%	+3.19784e+006
0.0%	+2.79811e+006
0.0%	+2.39838e+006
0.0%	+1.99865e+006
0.0%	+1.59892e+006
0.0%	+1.19919e+006
0.1%	+7.99459e+005
0.1%	+3.99730e+005
99.6%	+0.00000e+000

하중/반력합계

해석 케이스: asd

스텝: 선형 정적해석 (필수)

☑ 모든 절점 대상

절점 선택

하중/반력합 적용

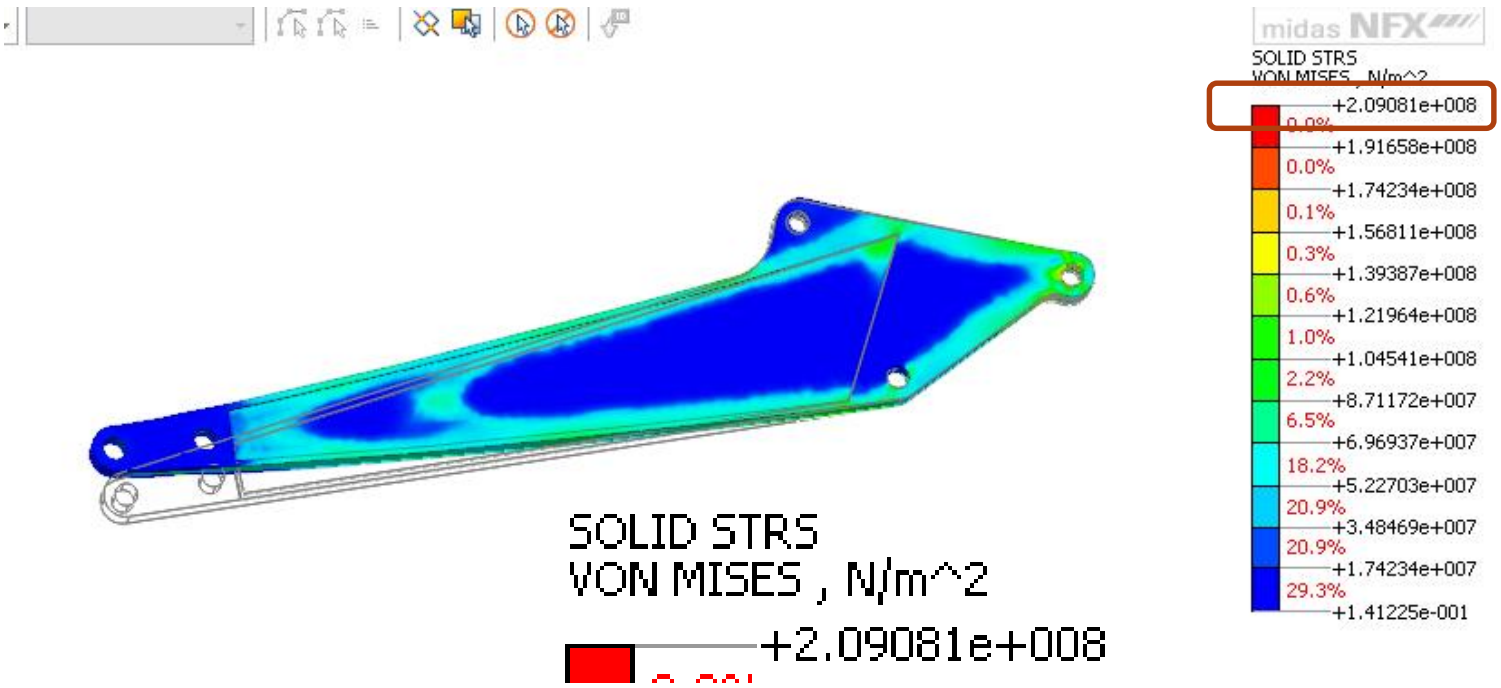
	방향	하중	반력
1	FX	0.0000	-0.0294
2	FY	16063800.0000	-16063799.9344
3	FZ	11852699.7188	-11852700.5276
4	MX	0.0000	0.0000
5	MY	0.0000	0.0000
6	MZ	0.0000	0.0000
7			

닫기

Z
Y X

A10H	16053800
A10V	11852700

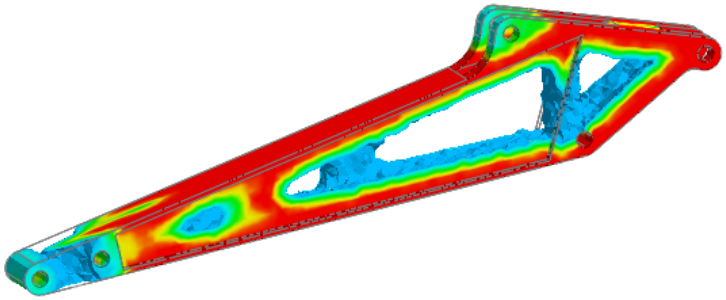
Linear Static Analysis - arm

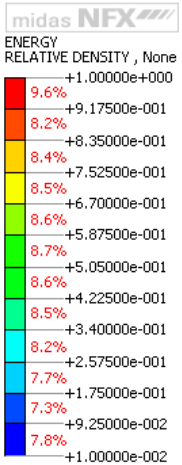


SM490A - yield strength : 325MPa

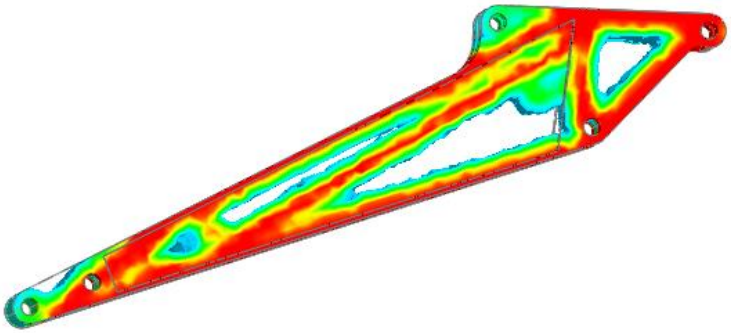
Topology Optimization - arm

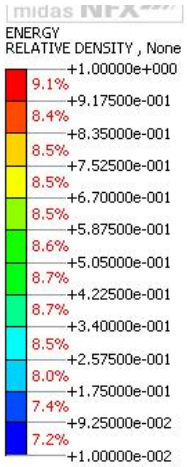
No symmetry condition





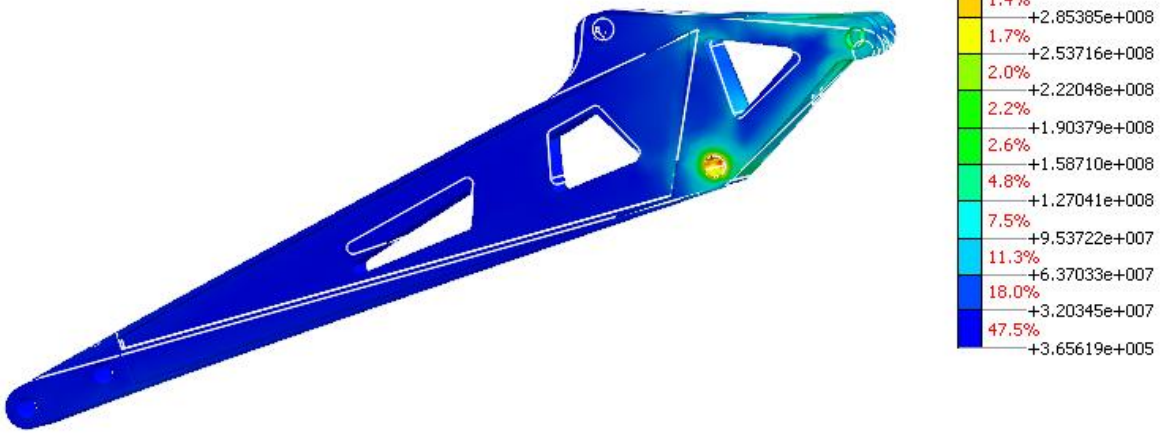
Symmetry condition





Revised Model Analysis - arm

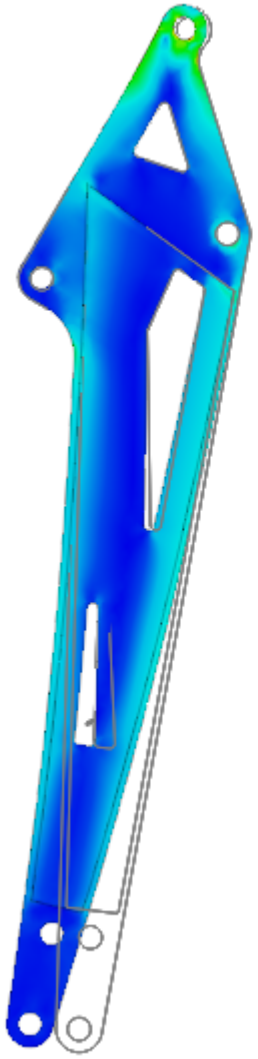
No symmetry condition

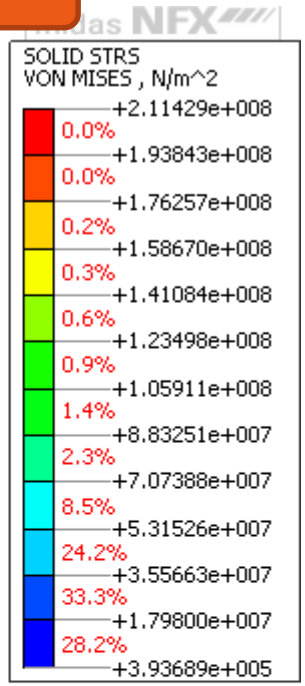


Bigger than 325MPa

Revised Model Analysis- arm

Symmetry condition



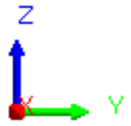


Smaller than 325MPa

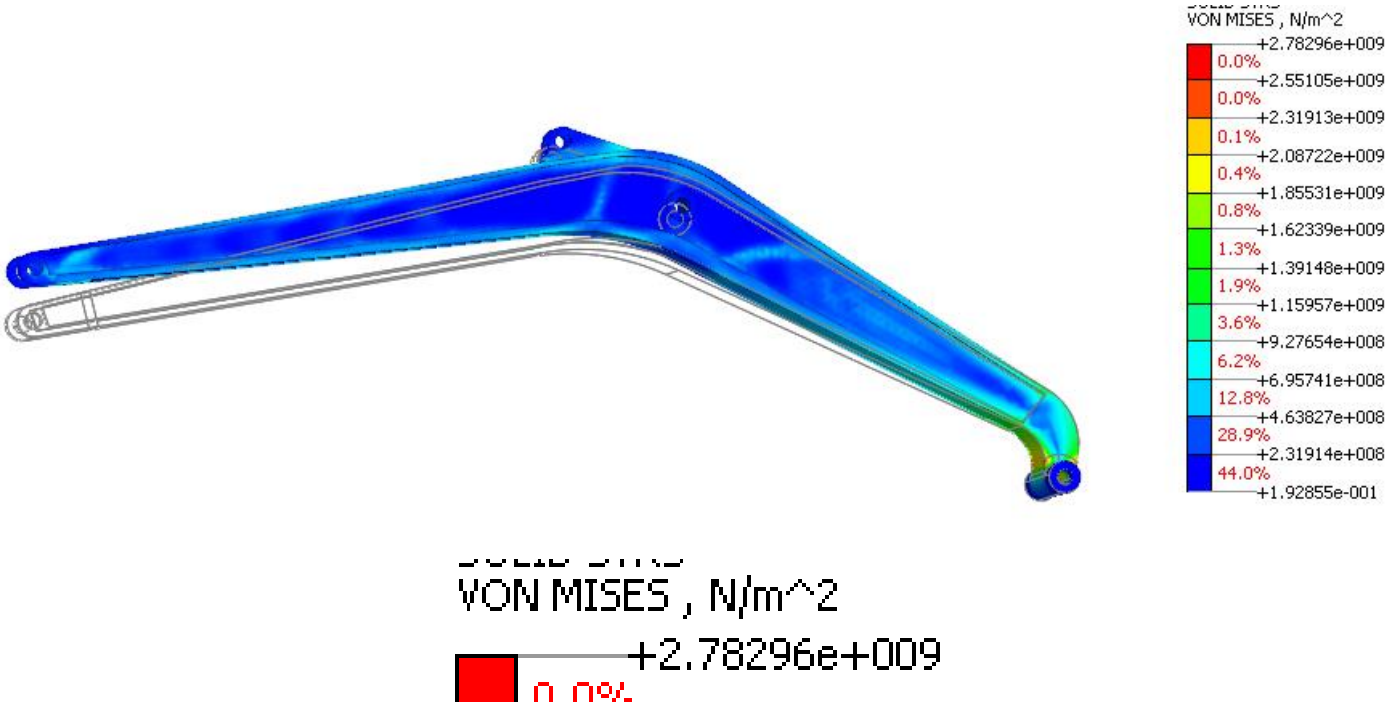
Before : 0.376 m^3
209MPa

After : 0.336 m^3
211MPa

11% volume down

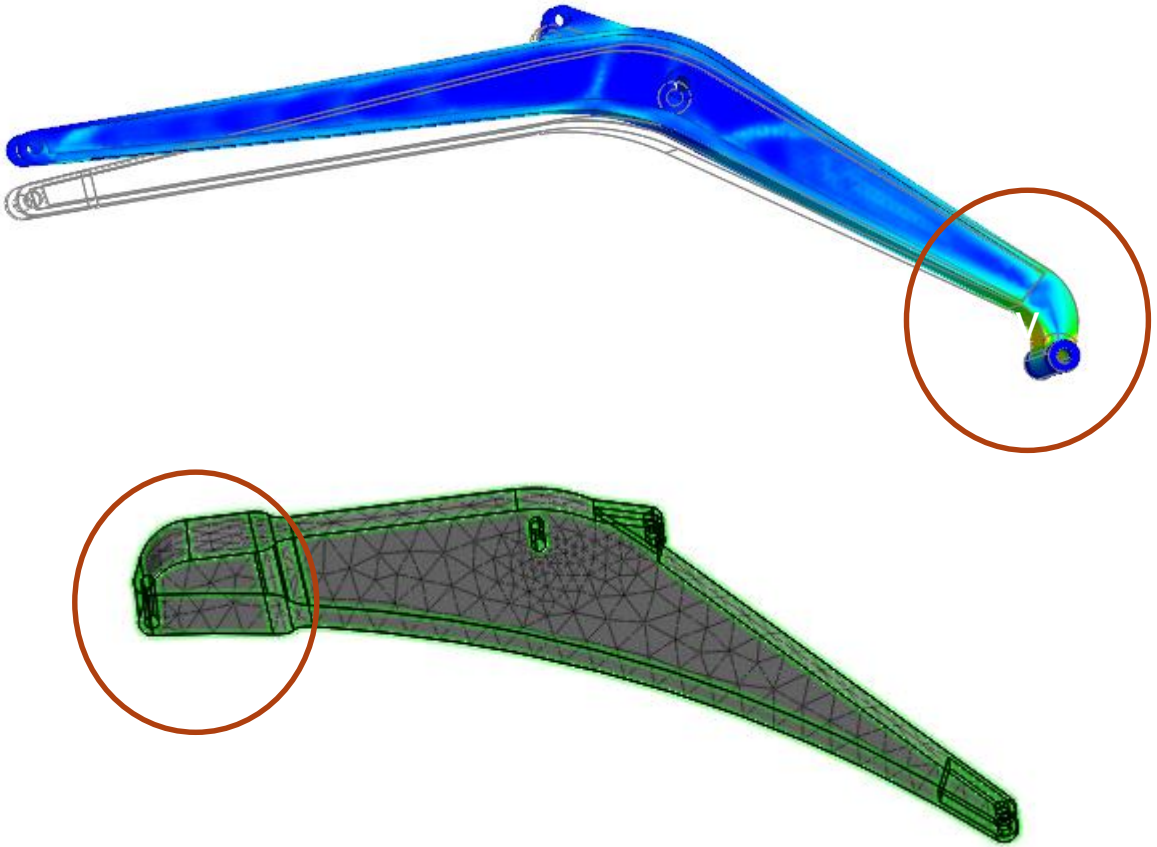


Linear Static Analysis - boom

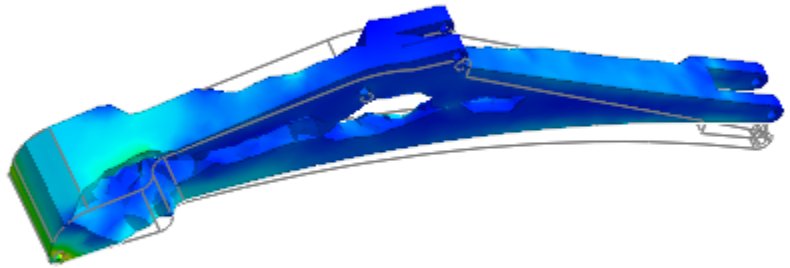


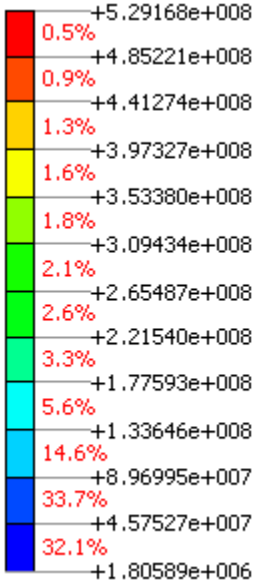
SM490A - yield strength : 325MPa

Topology Optimization - boom



Topology Optimization - boom





Reference

- 정한섭, ”30톤 급 굴삭기 작업장치의 동적 성능 최적화에 관한 연구“, 한서대학교 대학원 석사 학위 논문, 2017년 2월

- 남광식, 최진규, 최호민, 김재기, 염상훈, 이석순, " 굴삭기 작업장치의 설계 하중을 고려한 강도 개선에 대한 연구“, 한국기계가공학회지, 제15권, 제 1호

Q&A