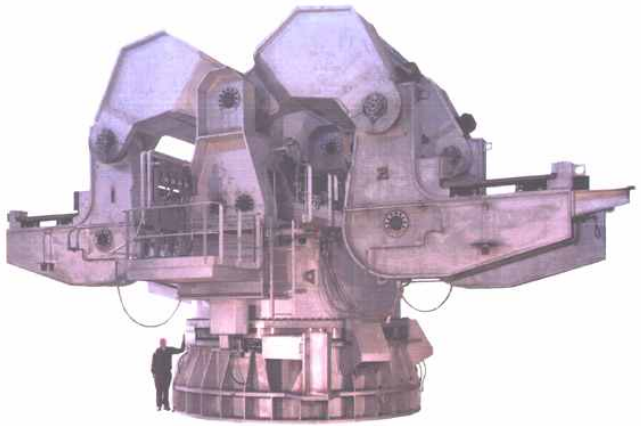
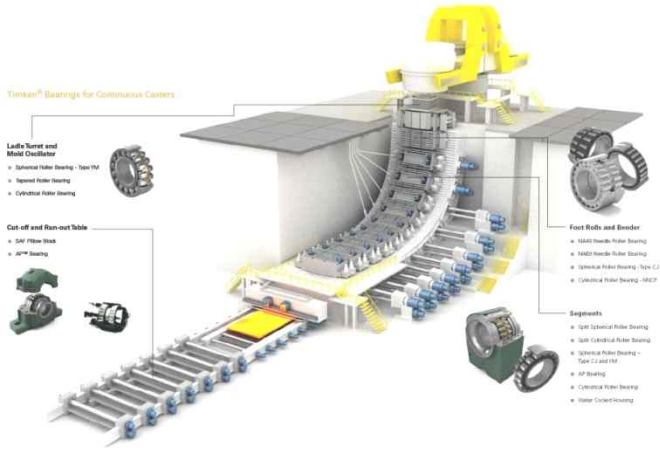
Hi, FEA

High Performance, Fast, Easy & Accurate

㈜삼원밀레니어 회 사 소 개 서





Samwon Millennia

(주)삼원밀레니어

목 차

1. 회사개요

업 체 명	(주)삼원밀레니어	대 표 자	이 지 현
설 립 일 자	2001년 09월 14일	주 생 산 품	신재생에너지 설비, 엔지니어링 서비스 외
본 사 소 재 지	경기도 용인시 기흥구 중부대로 182 기흥힉스유타워 지식산업센터 1607호		

※ 2011. 05 벤처기업 확인 (제20110102364호)

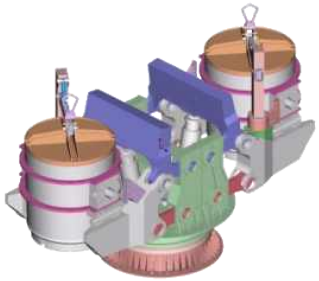
※ 2010. 04 이노비즈 확인 (제R7062-1449호)

※ 2002. 07 기술연구소 인정 (제20021972호)

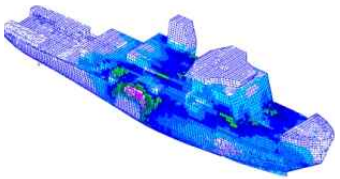
※ 2016. 04 청년 친화 강소기업 인증

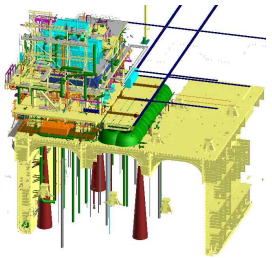
※ 2020. 07 수출 유망 중소기업 지정

※ 2020. 11 일자리 창출 우수기업 인증

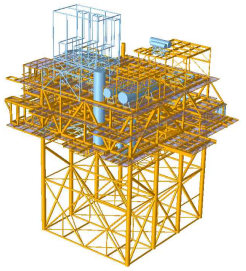


제철설비





조선/해양

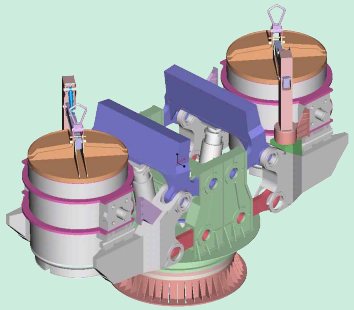


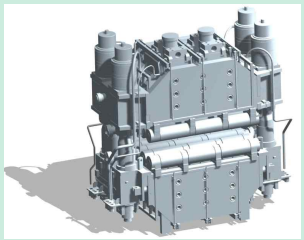
플랜트

풍력발전기/태양광발전

2. 보유기술 – 제철 설비 및 중공업

연주설비 설계



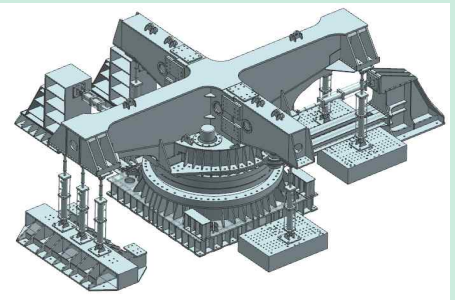


연주설비의
설계, 해석, 제작

크레인 개발

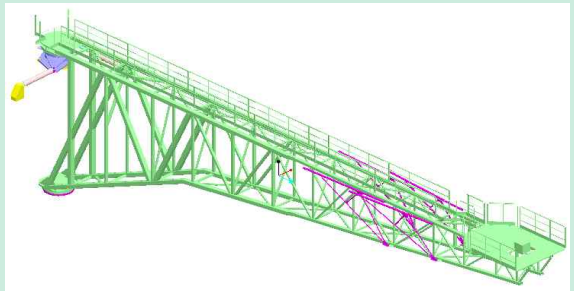
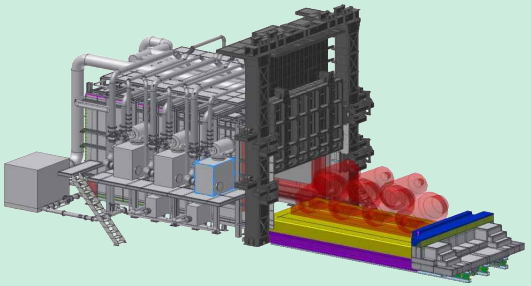
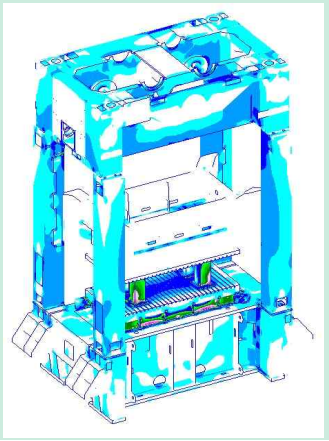
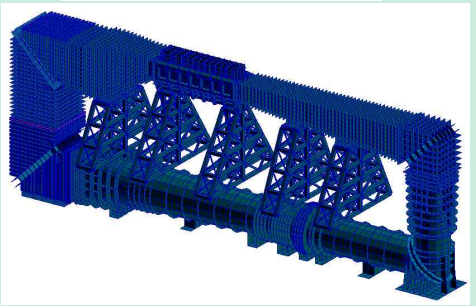
크레인의
설계, 해석, 제작

시험 장비 개발



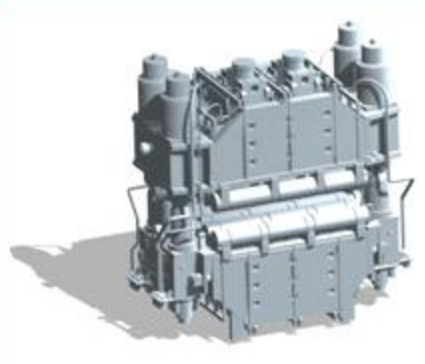
시험 장비의
설계, 해석, 제작

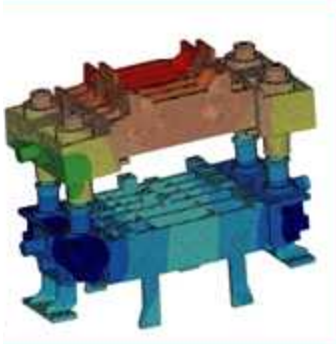
2. 보유기술 – 제철 설비 및 중공업

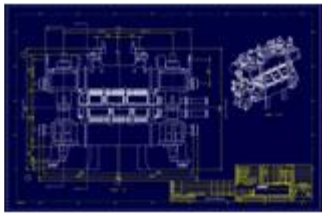
Burner boom 개발	가열로 설계	대형 구조물의 설계/해석
  Burner boom의 설계, 해석	  가열로의 설계, 해석	  대형 구조물의 설계, 해석

3. 수행 프로젝트 및 컨설팅 실적

- POSHARP segment 기본설계, POSCO
- POSHARP용 시험연주기 segment 설계변경, POSCO
- POSHARP용 시험연주기 segment 해석 및 설계, POSCO
- LoDSIL을 위한 3차원 모델링 및 최적화 설계, POSCO
- Pinching Force 변화에 따른 권취 토크 평가, POSCO
- 2선재공장 조압연 MILL 베어링 파손 원인 분석, POSCO
- 전기강판 CVC Mill 모델링 및 해석, POSCO
- Posco Segment Oscillator, POSCO
- 300ton Ladle Turret 개발, POSCO
- POSCO형 연주설비 개발, POSCO
- Cable 설계 프로세스 자동화 기법 개발, POSCO
- 3차원 케이블 트레이 설계 프로그램 구축 및 컨설팅, POSCO
- 3차원 배관자동설계 프로그램 구축 및 컨설팅, POSCO
- 연주설비 설계기술 국산화, POSCO
- 60ton Roll Tongs 구조 해석 및 작동성 검토(기구학해석), 신강정공(POSCO)
- 90ton Ladle Turret 재설계, 현대제철
- Jaw Crusher 구조 설계, INI Steel㈜ 기계 사업부
- 항만 하역용 Grab 작업 특성 분석 및 역설계, 동기상사



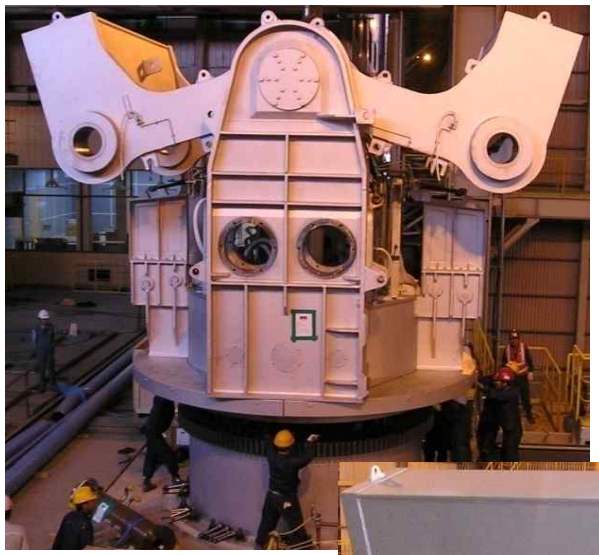




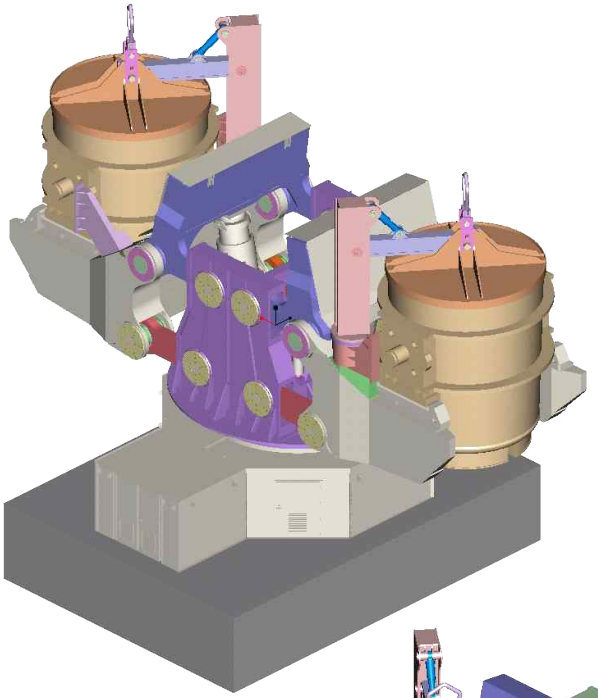
4. 주요 수행 프로젝트
- 제철/중공업 분야 -

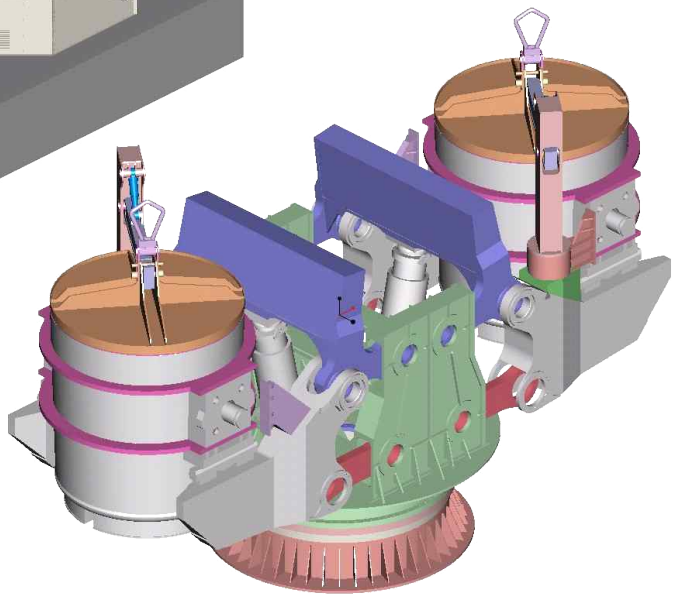
300톤 Ladle Turret 개발

- 3차원 설계 및 CAE 기술을 이용한 국내의 기술로 **300톤 Ladle Turret의 설계국산화**를 하였다.

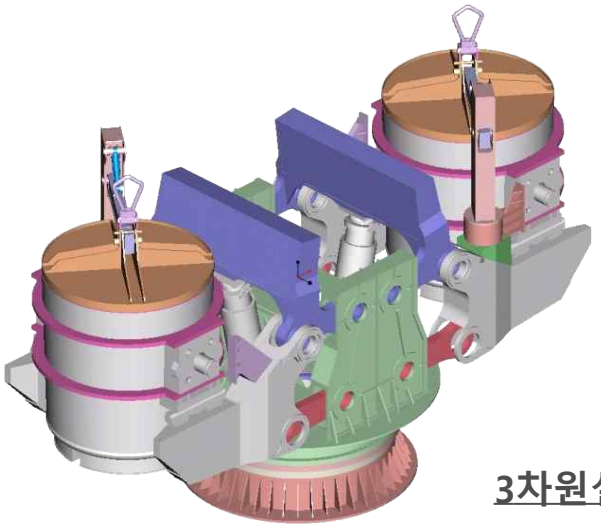


Ladle Turret

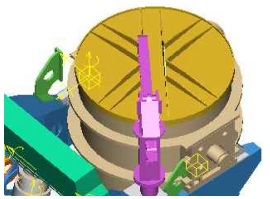




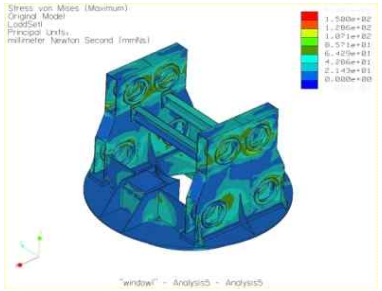
300톤 Ladle Turret 개발(계속)

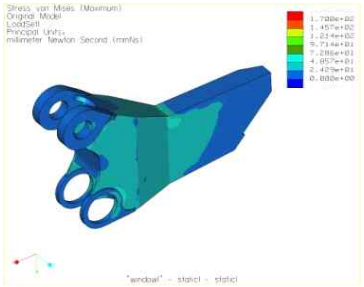


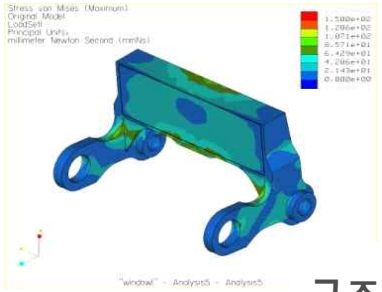
3차원설계



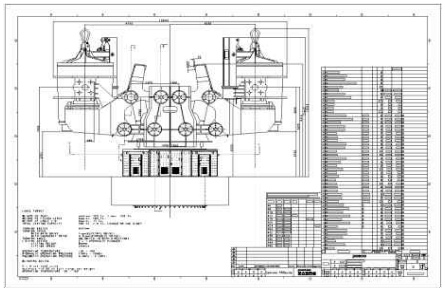
동역학 해석

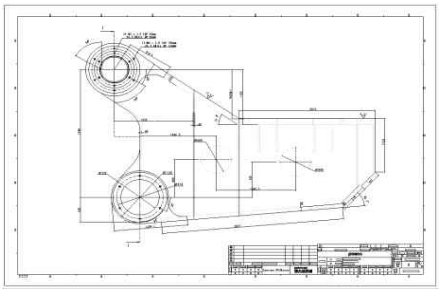


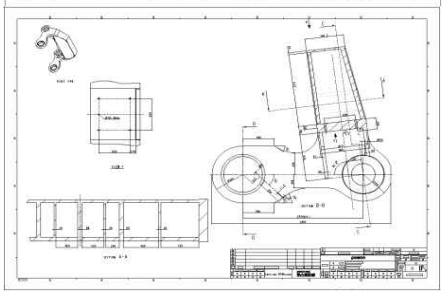


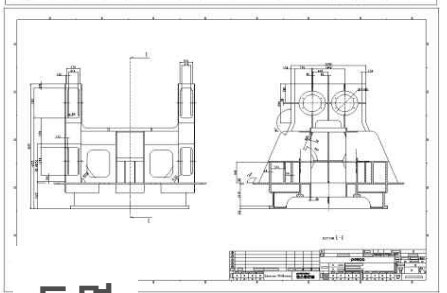


구조해석



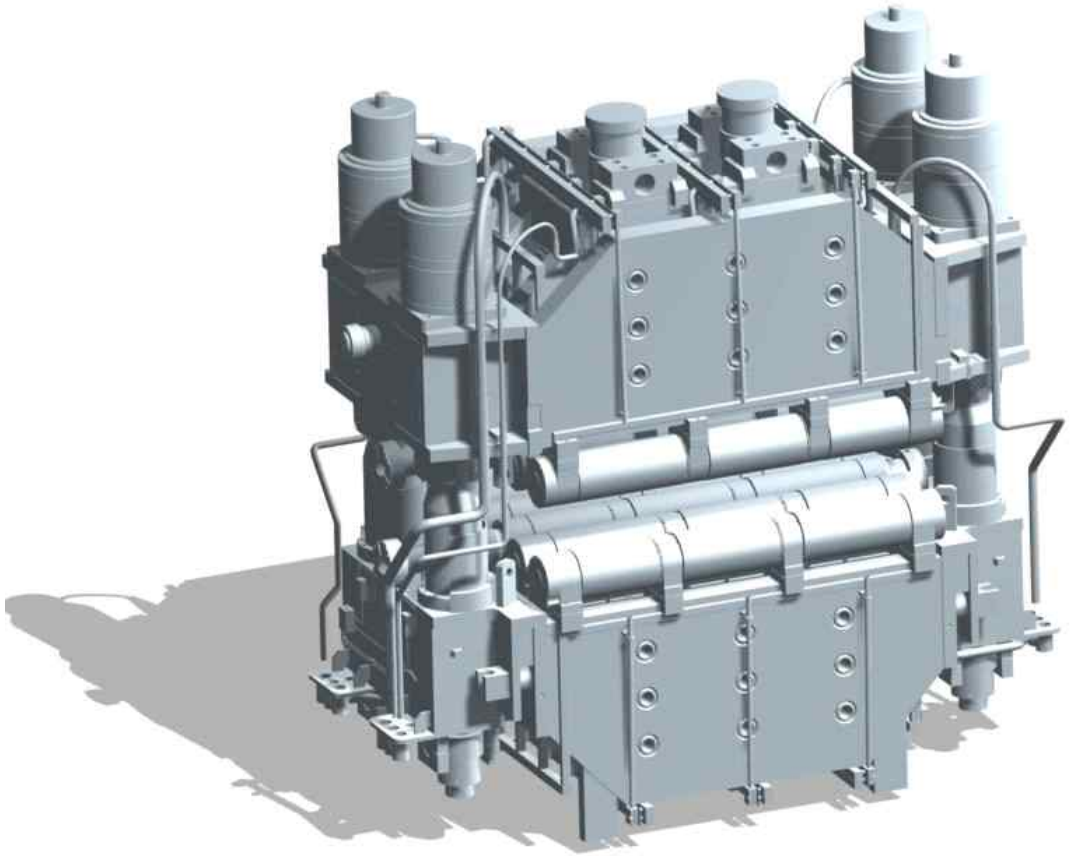






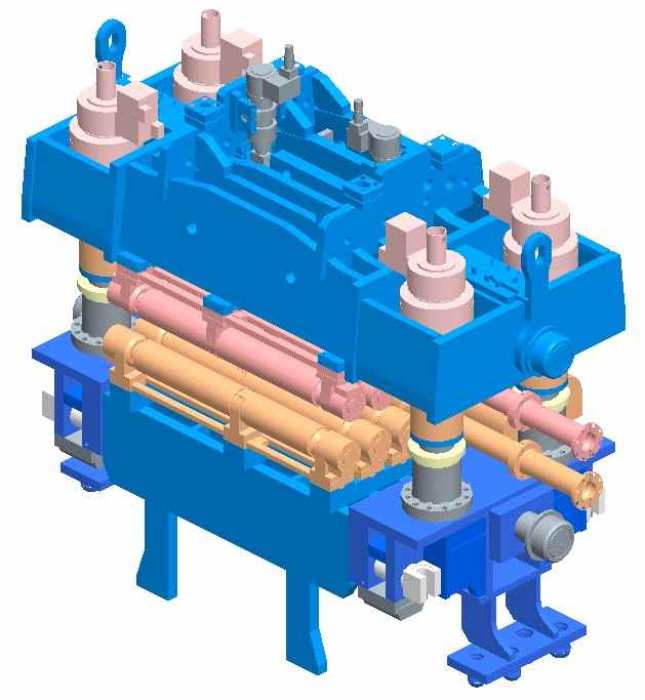
도면

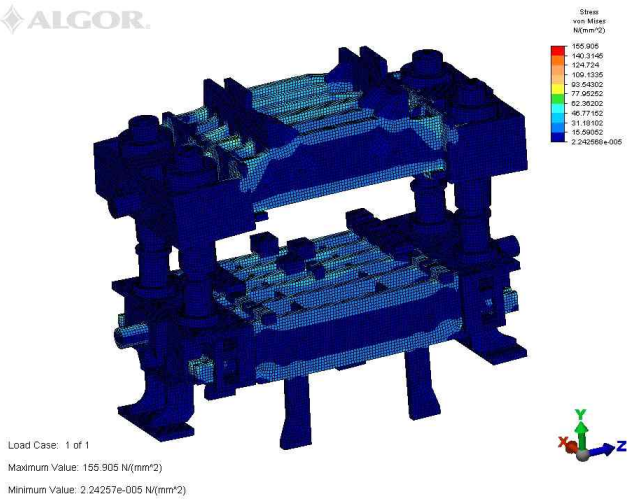
POSHARP Segment 기본설계

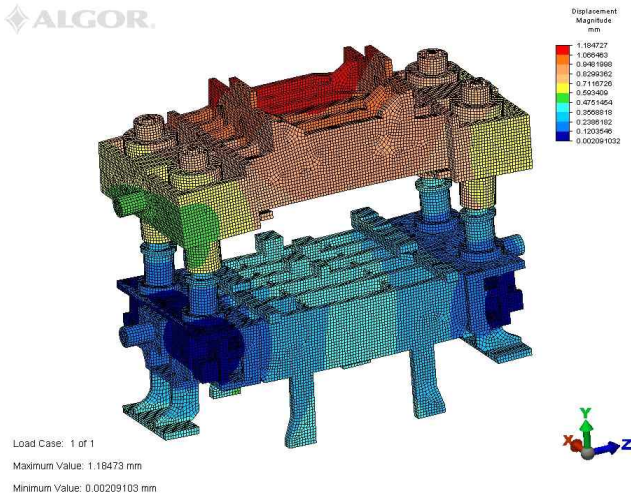


POSHARP용 시험 연주기 Segment 설계 및 해석

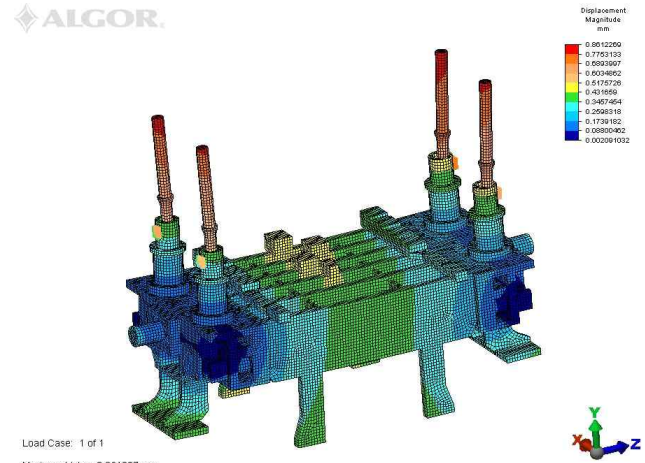
- 3차원 설계 및 해석

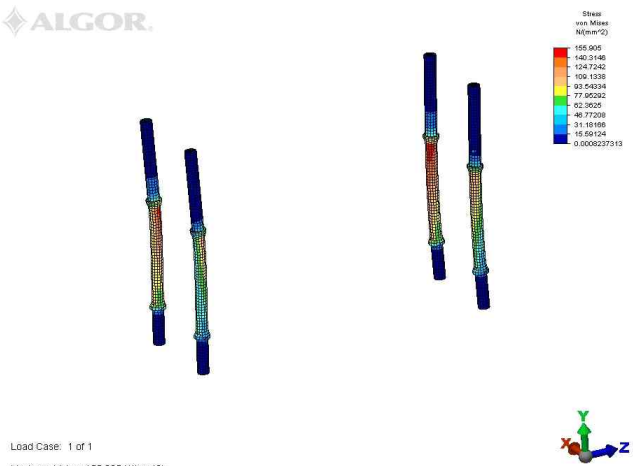






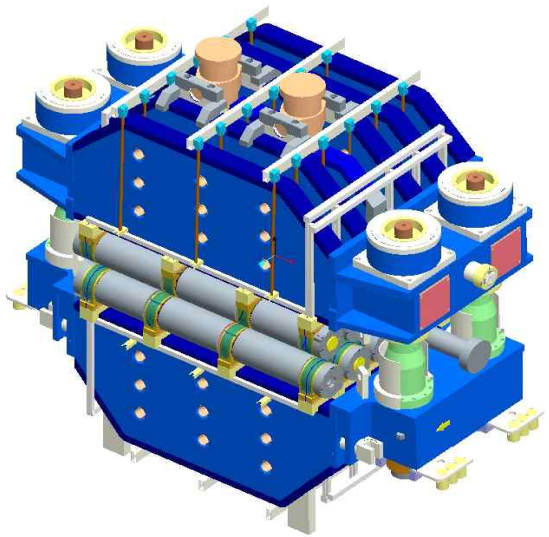
Frame Analysis

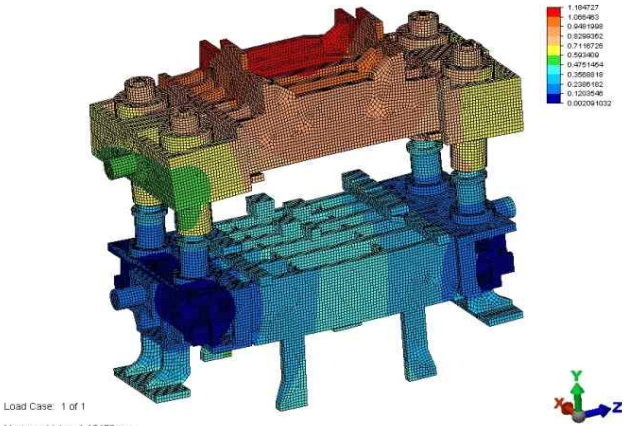


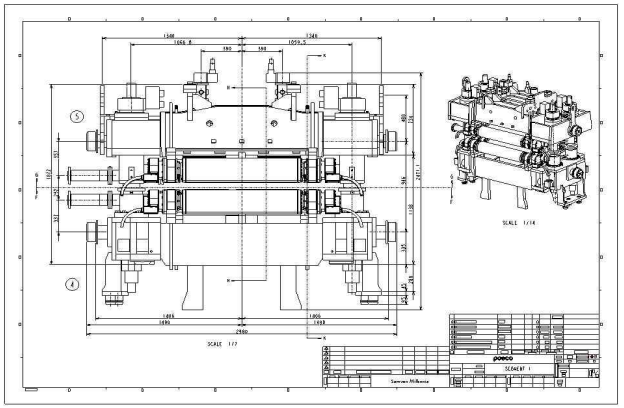


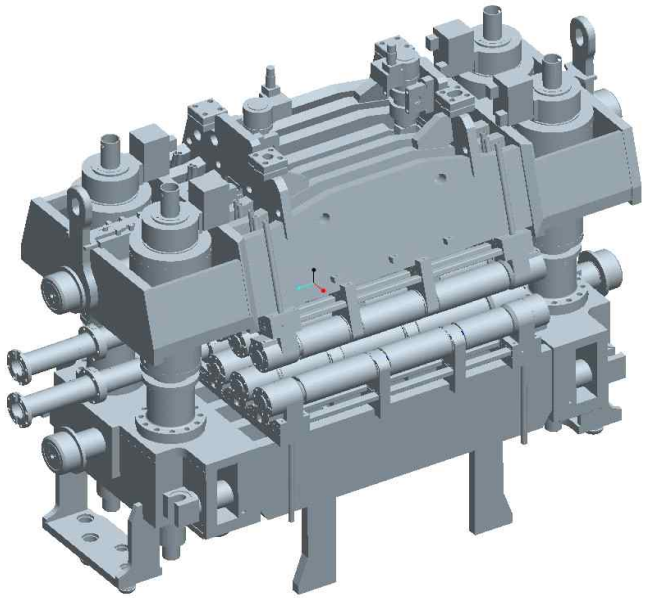
Tie_Rod Analysis

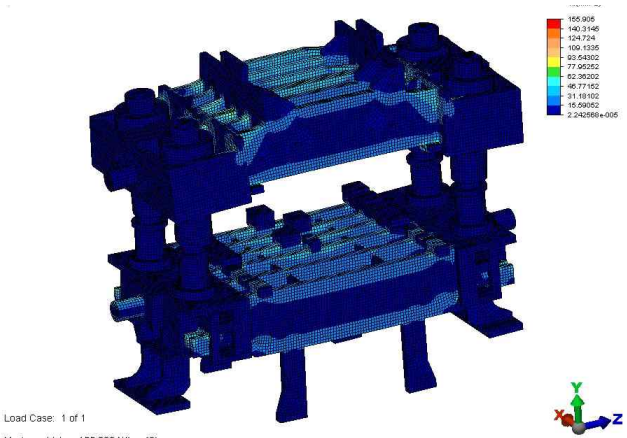
POSHARP용 시험 연주기 Segment 설계 및 해석

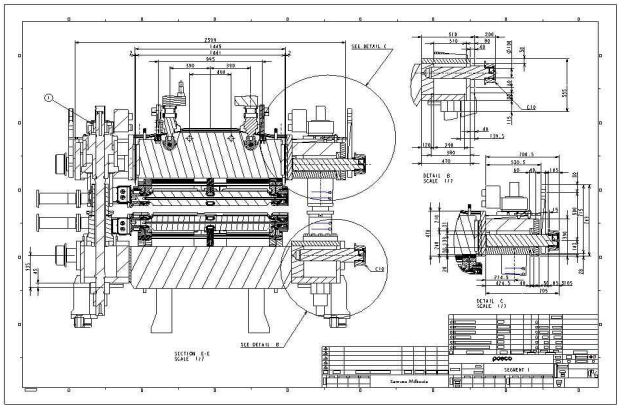






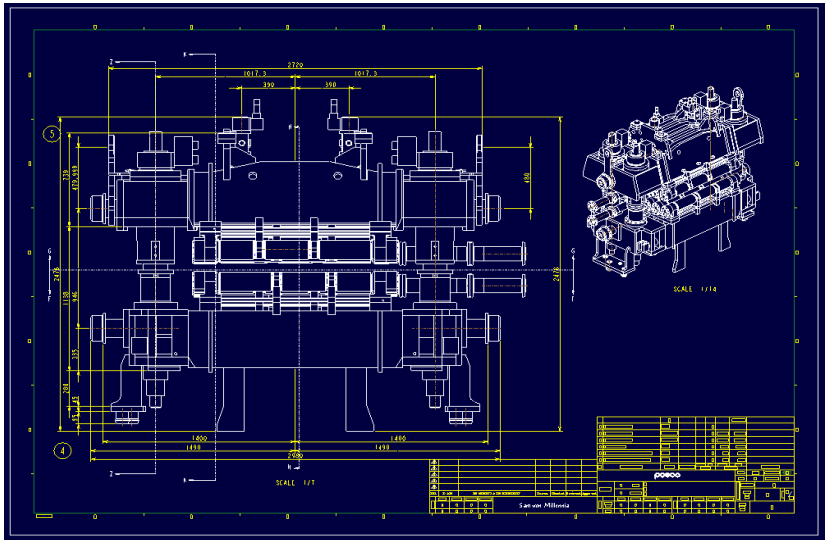


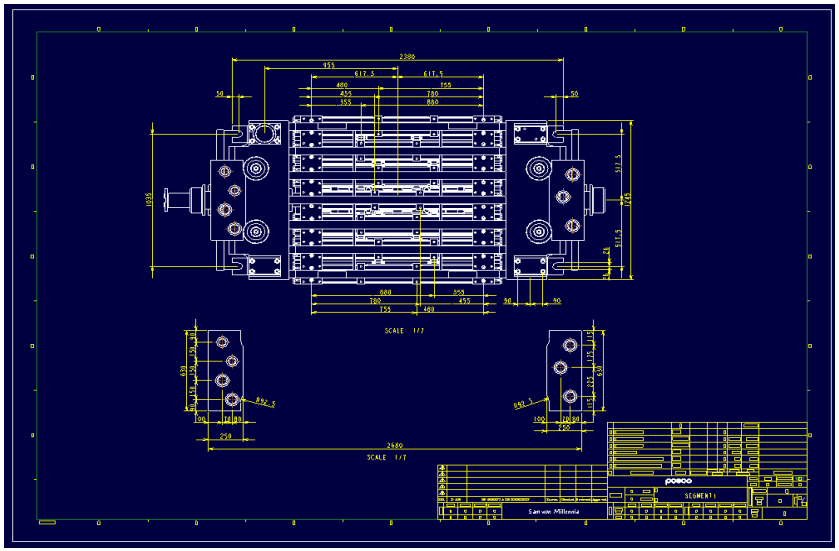


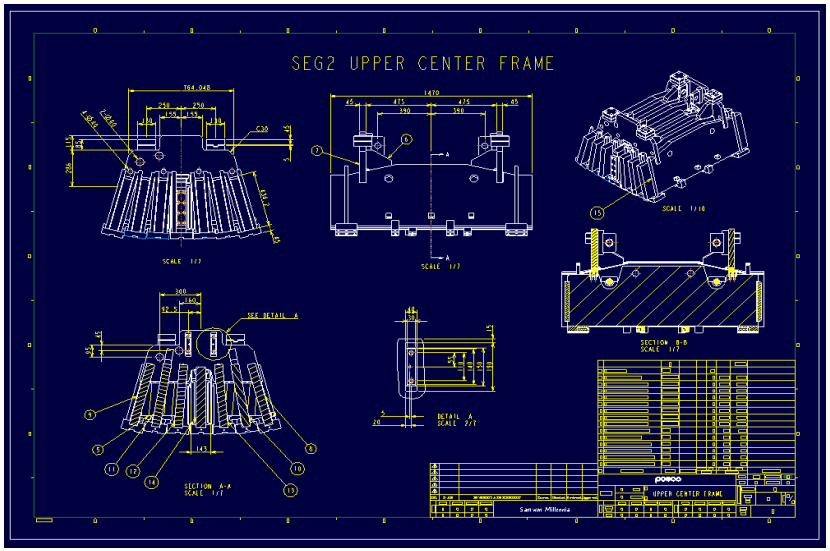


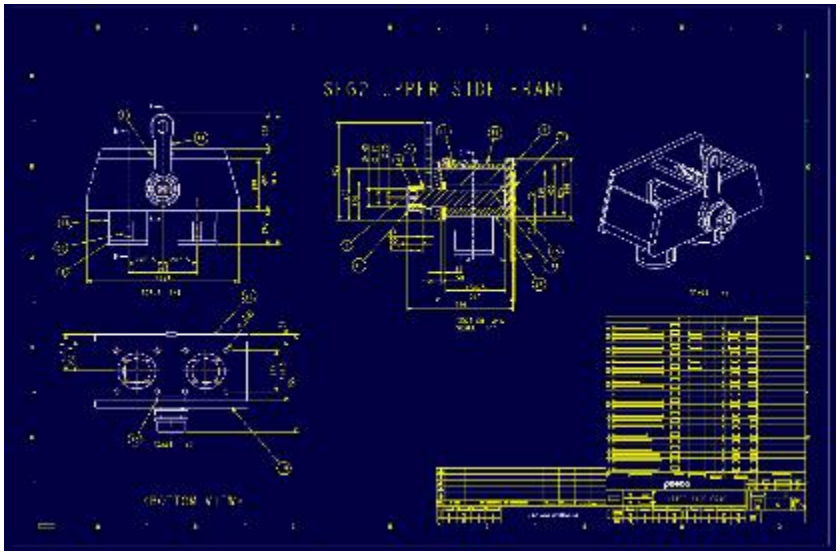
POSHARP용 시험 연주기 Segment 설계 및 해석

- 도면 제작



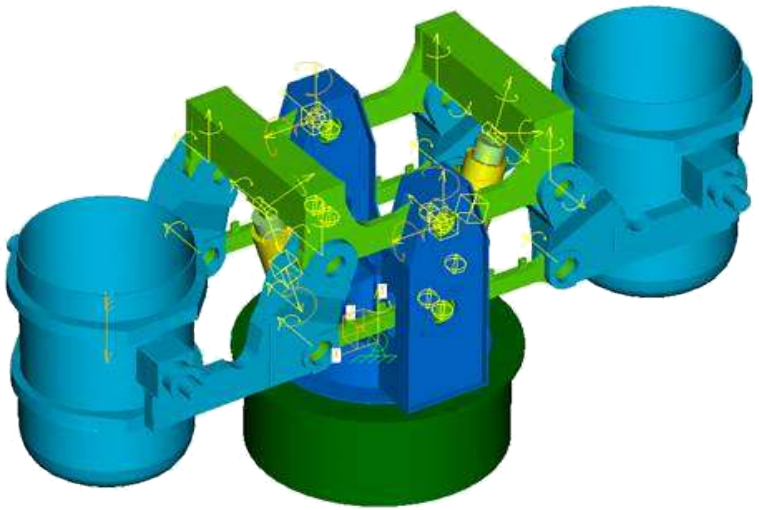


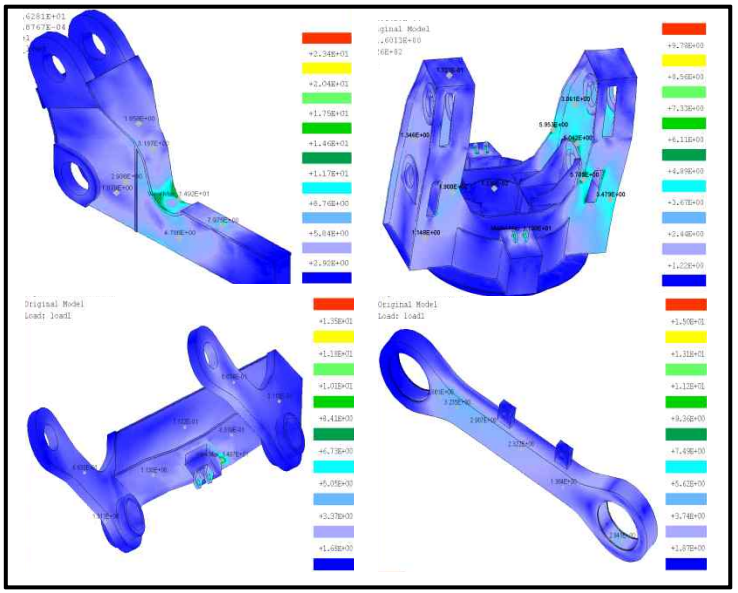




Ladle Turret 개발

- 3D CAD & CAE를 이용한 설계 기술 개발 – 설계 국산화
- Ladle Turret – 다물체 동역학 해석 및 구조 해석

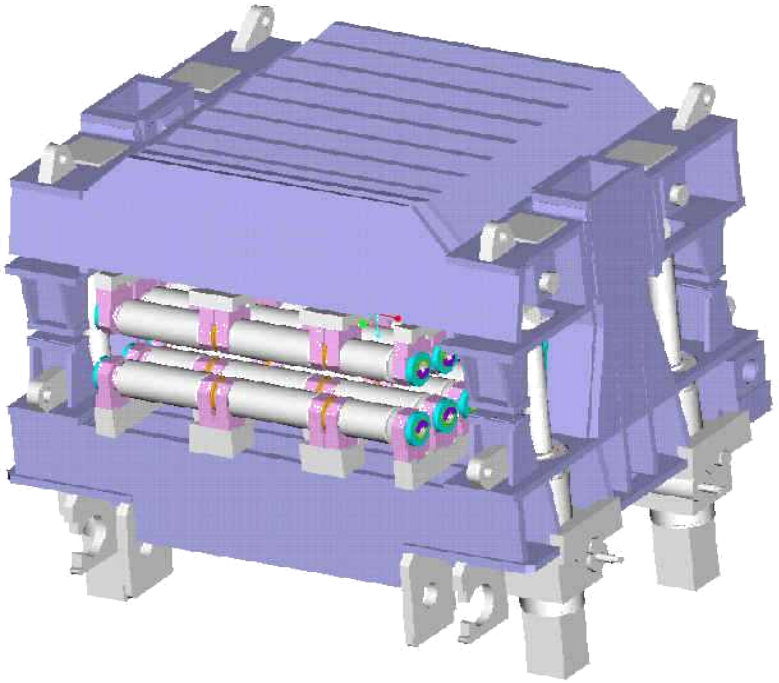




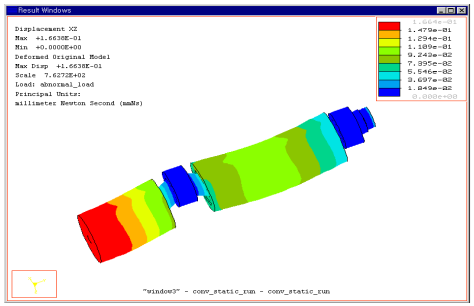
다물체 동역학 해석 → 조인트 반력 → 구 조 해 석

POSCO형 연주설비(국산화)

- 3D CAD & CAE를 이용한 설계 기술 개발 – **설계 국산화**
- Segment - Inner & Outer Frame, Roll, Tie Rod, Bracket(구조해석)



Frame



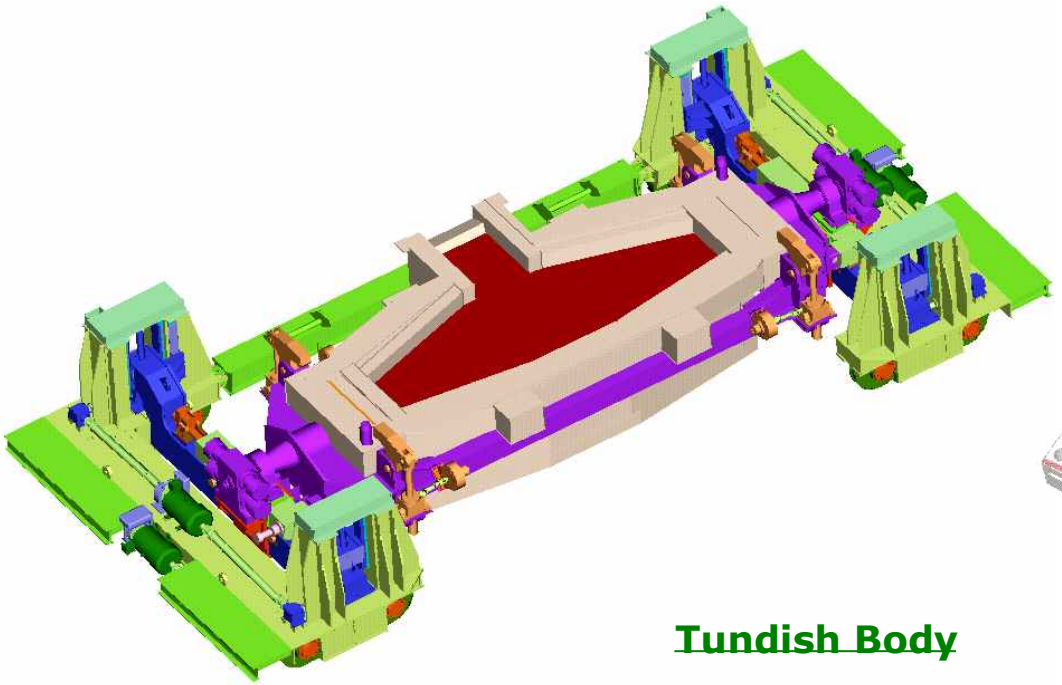
Roll

Tie_Rod

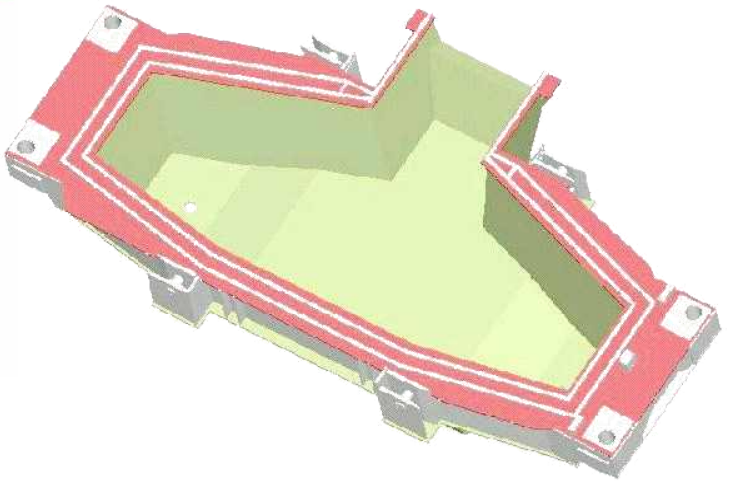
Bracket

POSCO형 연주설비(국산화)

- 3D CAD & CAE를 이용한 설계 기술 개발
- 구조해석

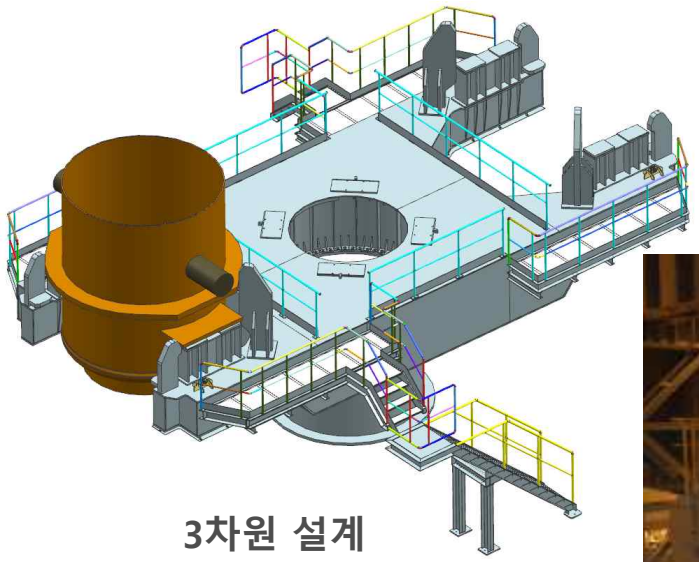


Tundish Body

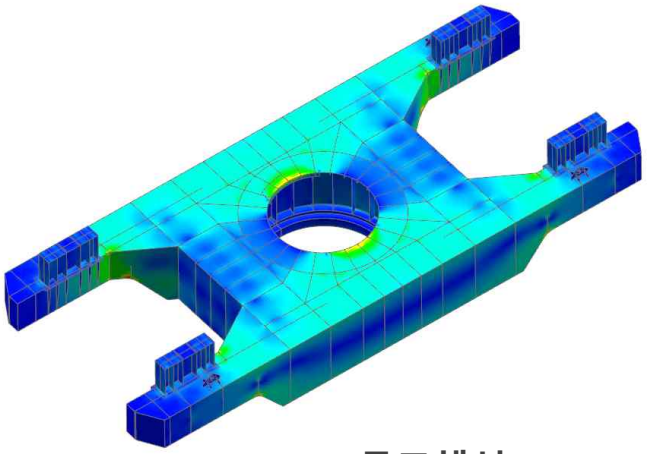


90ton Ladle Turret 재설계 및 제작

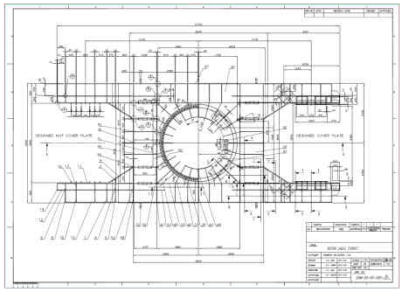
- 현재 설치되어 있는 외국 업체의 제철 설비 개보수를 위하여 엔지니어링 기술은 필수적 이다.
- 축적된 제철 분야의 엔지니어링 기술을 바탕으로 90ton Ladle Turret의 재설계 및 제작을 수행하였다.



3차원 설계



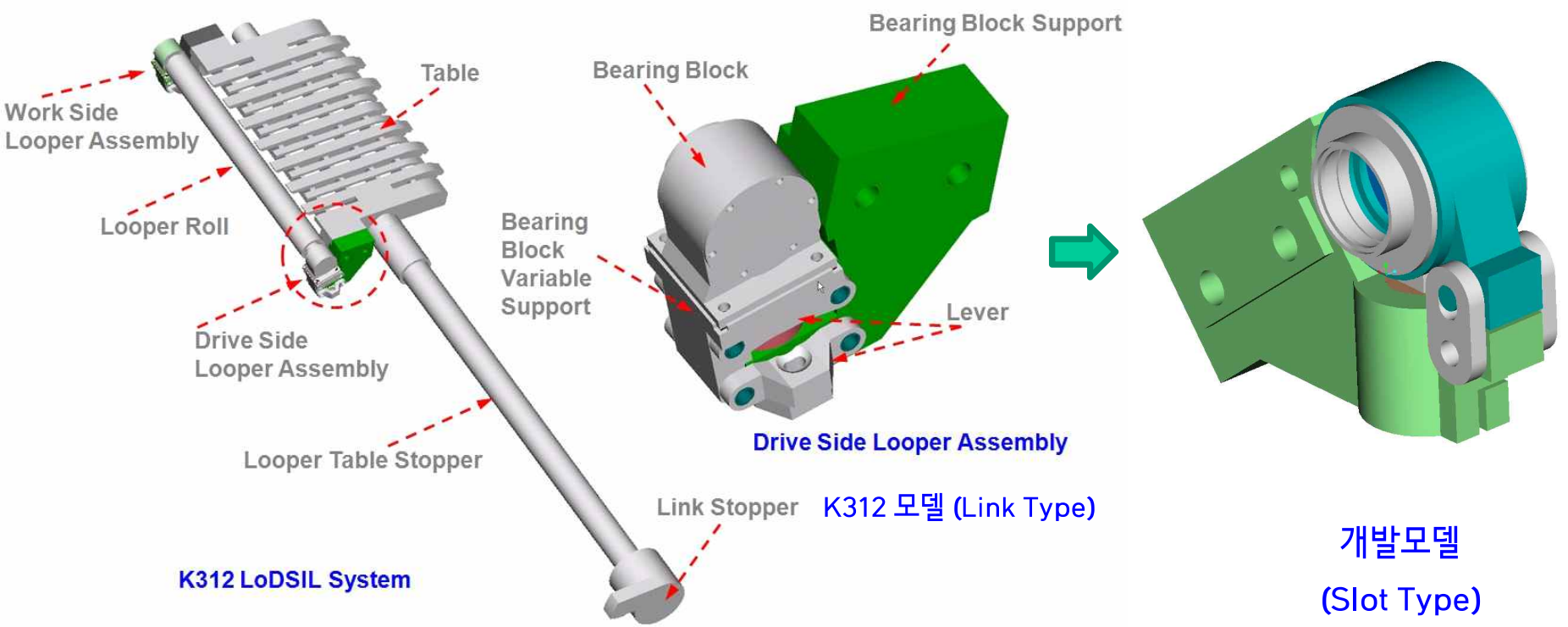
구조해석



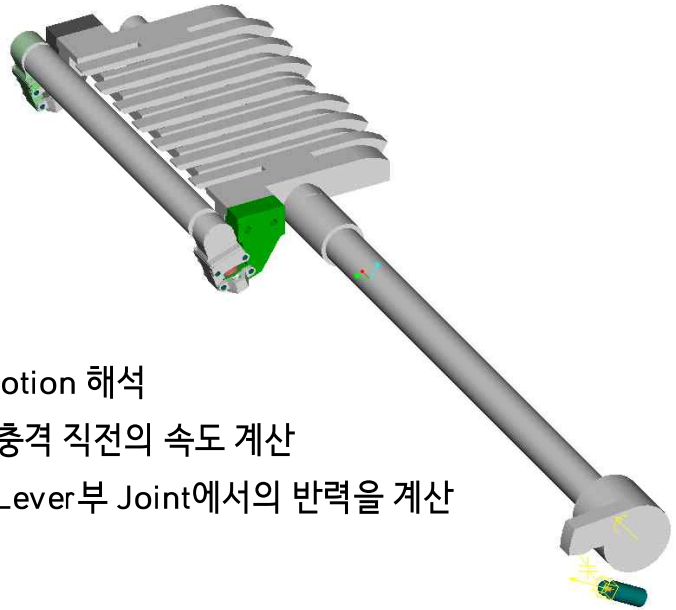
제작

LoDSIL 최적설계

- 목적 : K312 LoDSIL 시스템의 열간 사상 압연 공정 중에 발생하는 정하중 조건과 정비 완료 후 원위치로 되돌릴 때 발생하는 충격 하중 조건에 대하여 LoDSIL 시스템의 구조 강도를 평가하고, 개선된 효율적인 모델 설계에 있다.



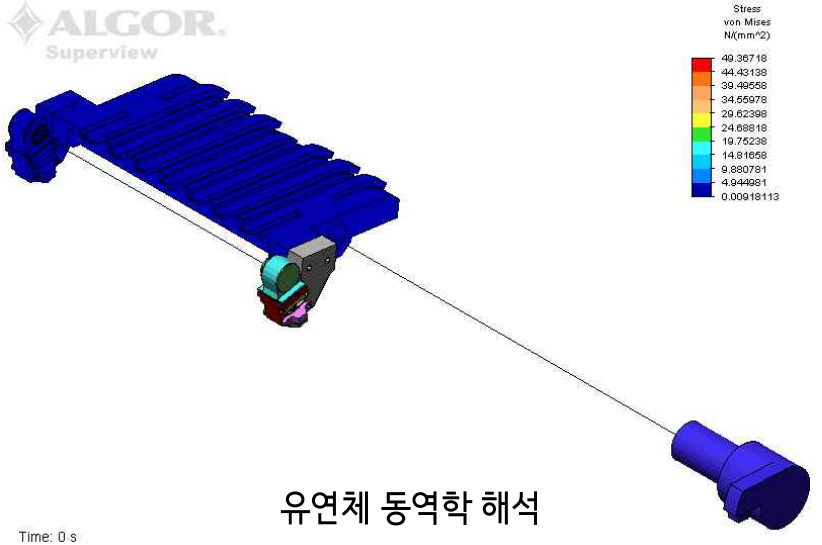
LoDSIL 최적설계 – 기존모델해석



Motion 해석

–충격 직전의 속도 계산

–Lever부 Joint에서의 반력을 계산



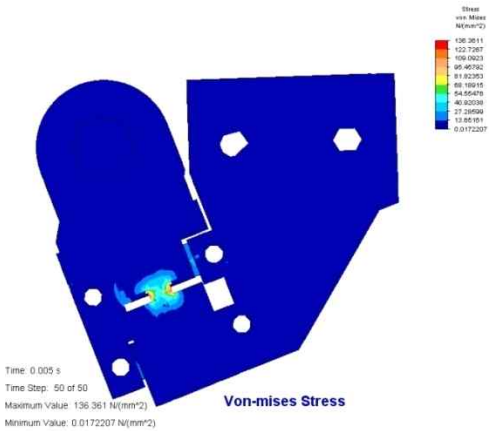
유연체 동역학 해석

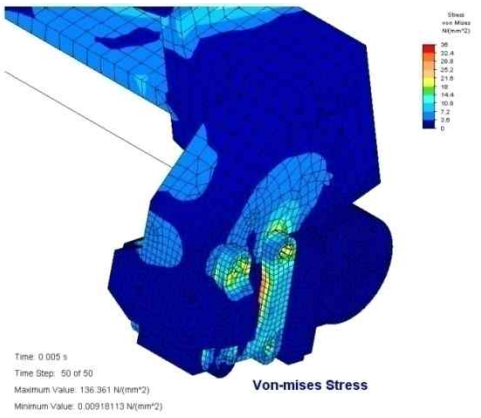
Time: 0 s

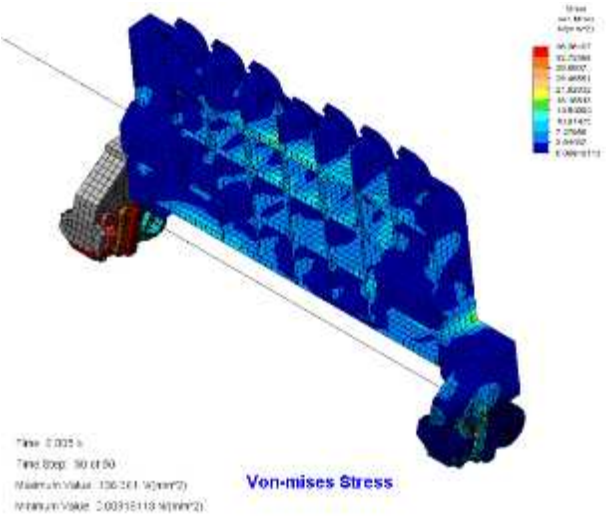
Time Step: 0 of 50

Maximum Value: 0 N/(mm^2)

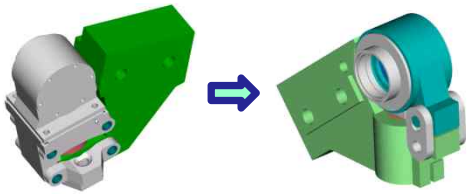
Minimum Value: 0 N/(mm^2)

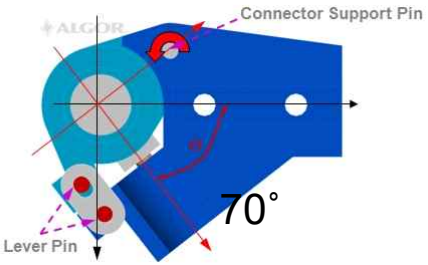


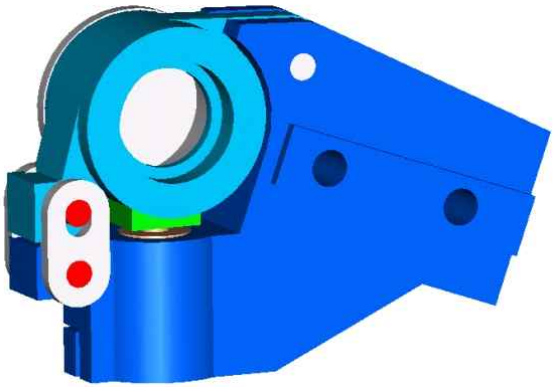


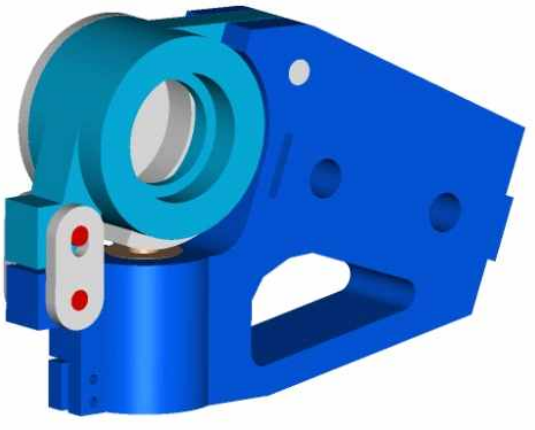


LoDSIL 최적설계 – Bearing Block Support 형상 최적화

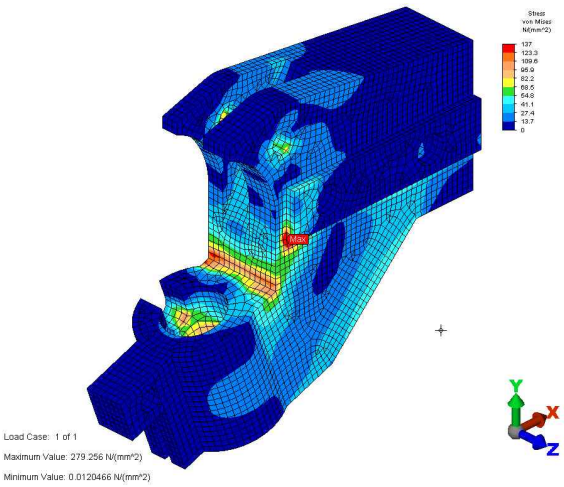


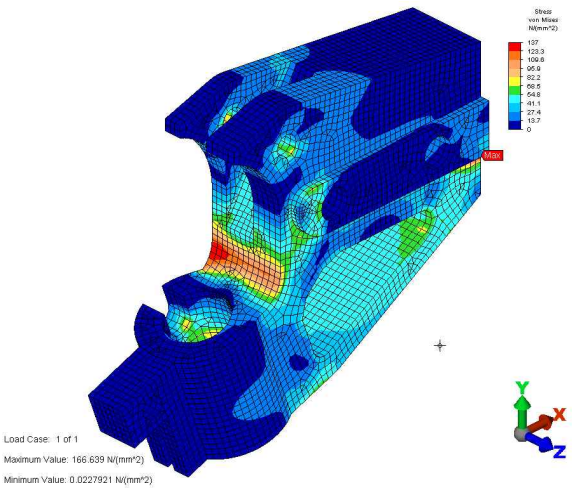






최적화 모델

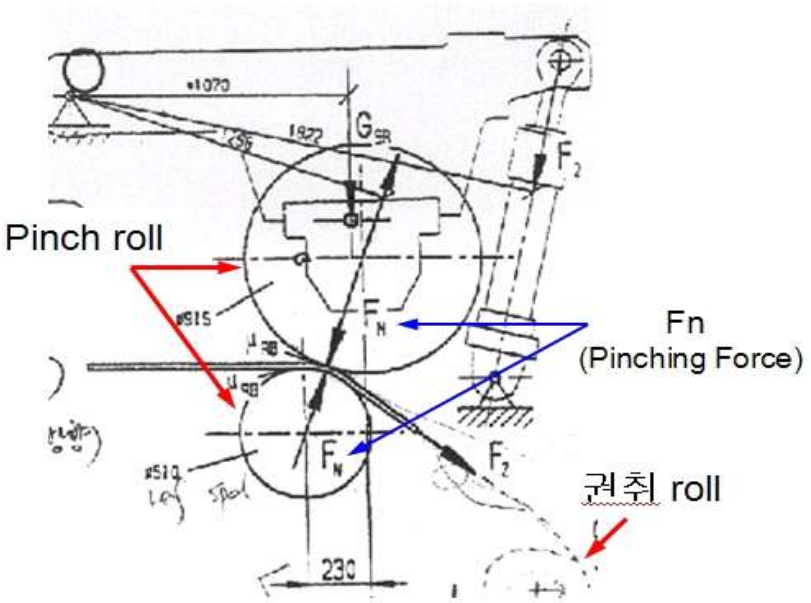


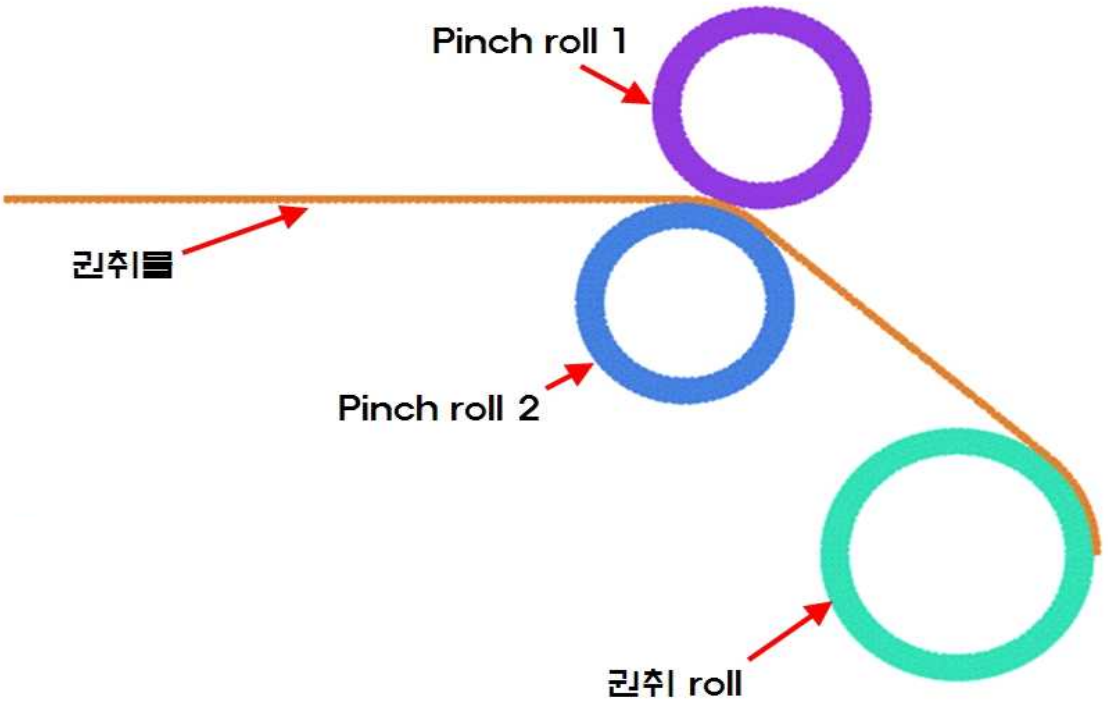


Pinching Force 변화에 따른 권취 Torque 평가

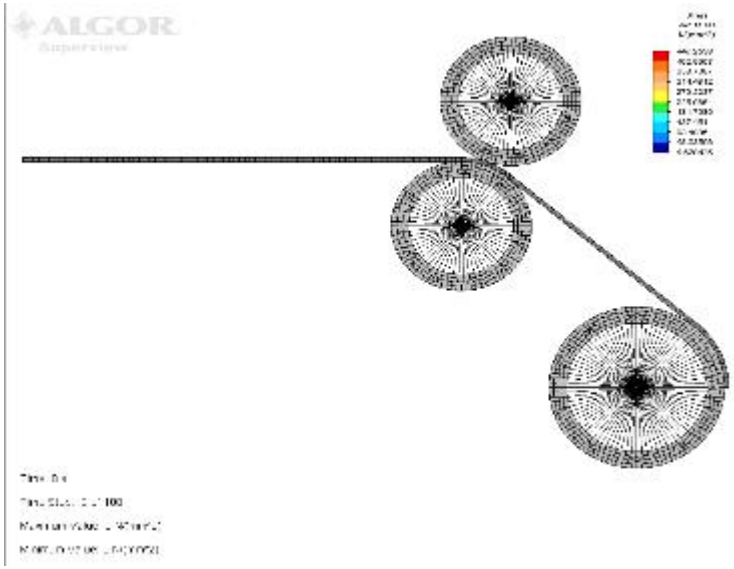
- **목 적**

  권취 시 필요한 임계 Pinching force 계산 및 Pinching Force 변화에 따른 권취 Torque 평가.

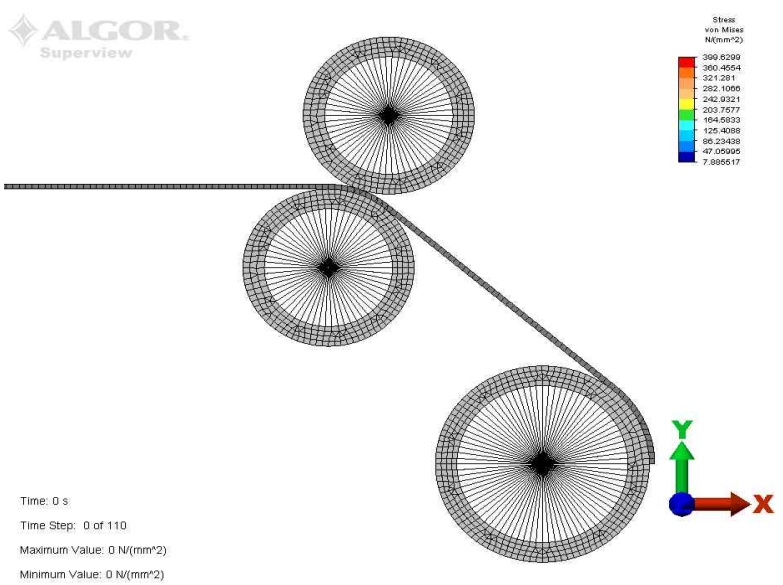




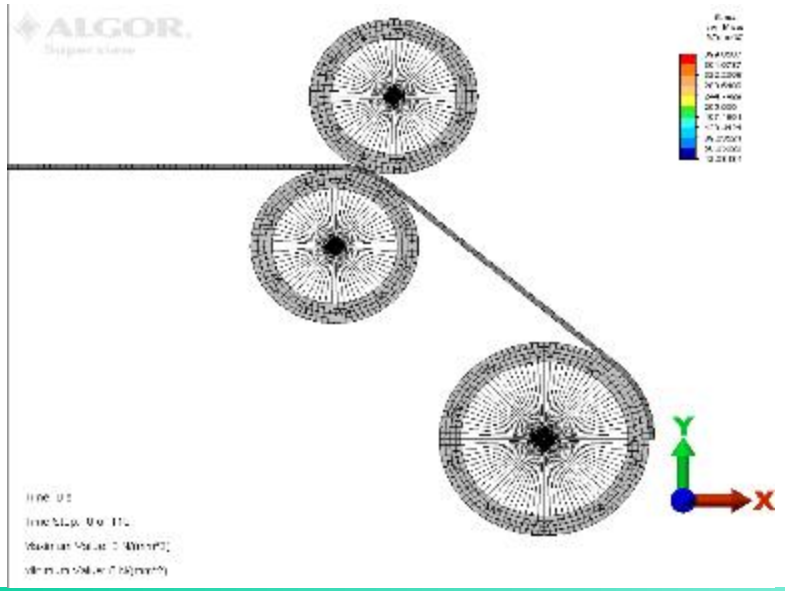
Pinching Force 변화에 따른 권취 Torque 평가

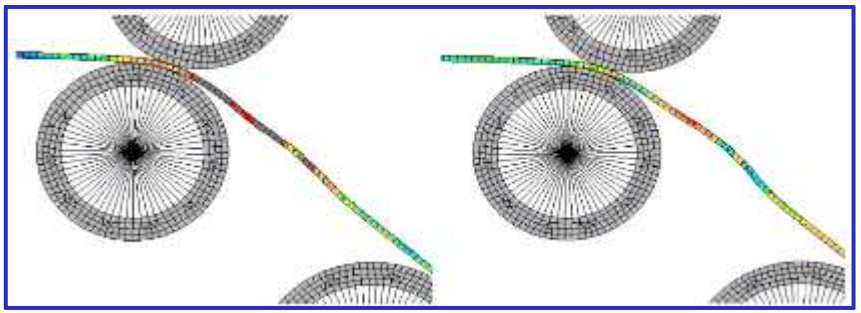


Pinching Force 배제



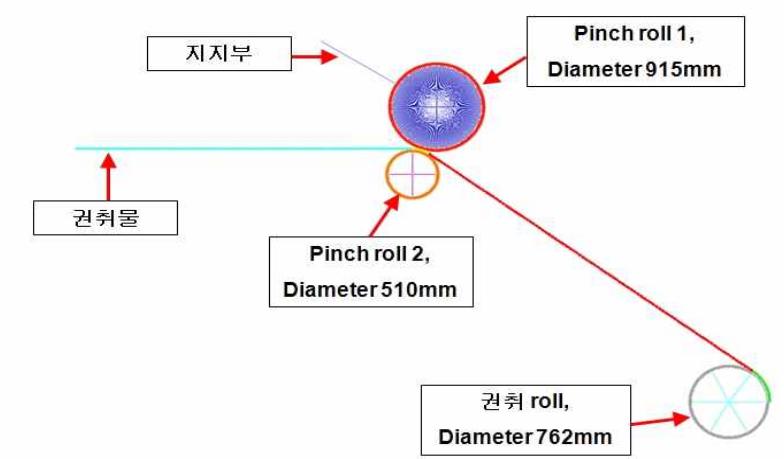
Pinching Force 적용



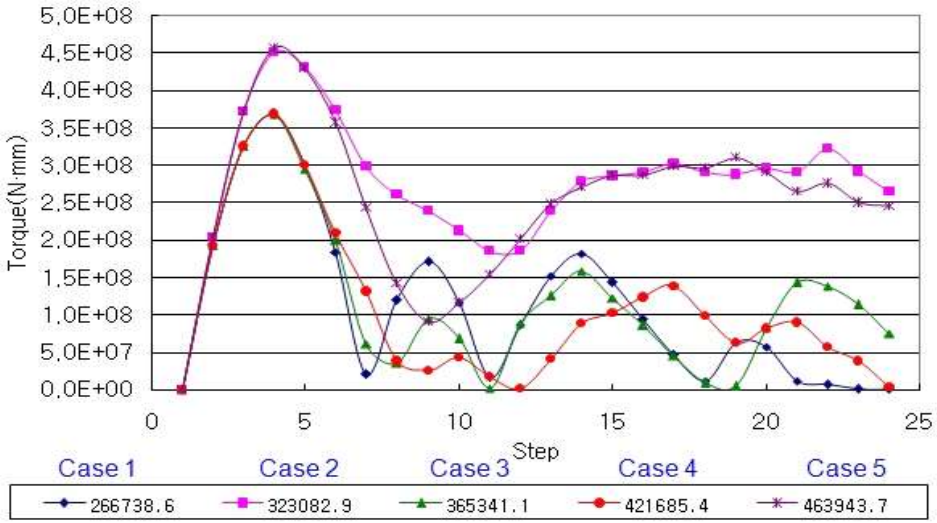


Pinching Force 70% 적용

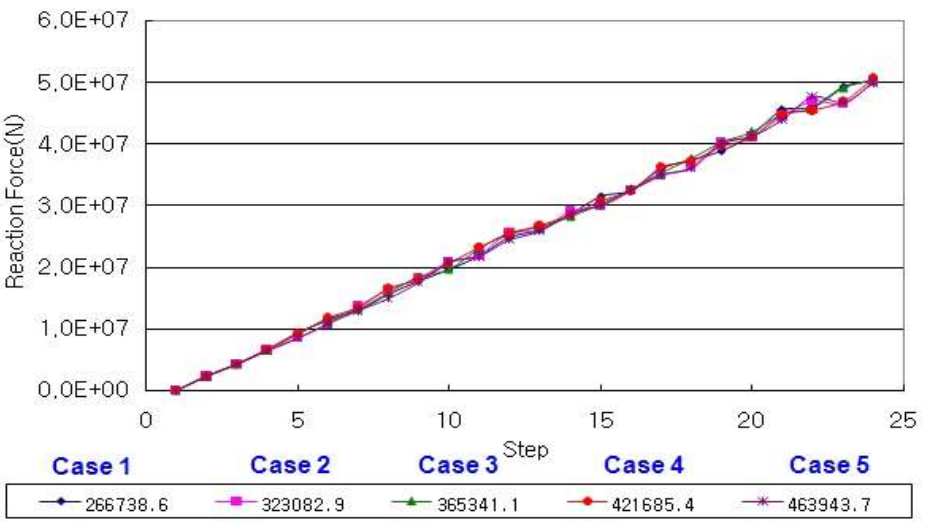
Pinching Force 변화에 따른 권취 Torque 평가



F2(N)	160000	200000	230000	270000	300000
Gsr(N)	50000	50000	50000	50000	50000
Fn(N)	266739	323083	365341	421685	463944

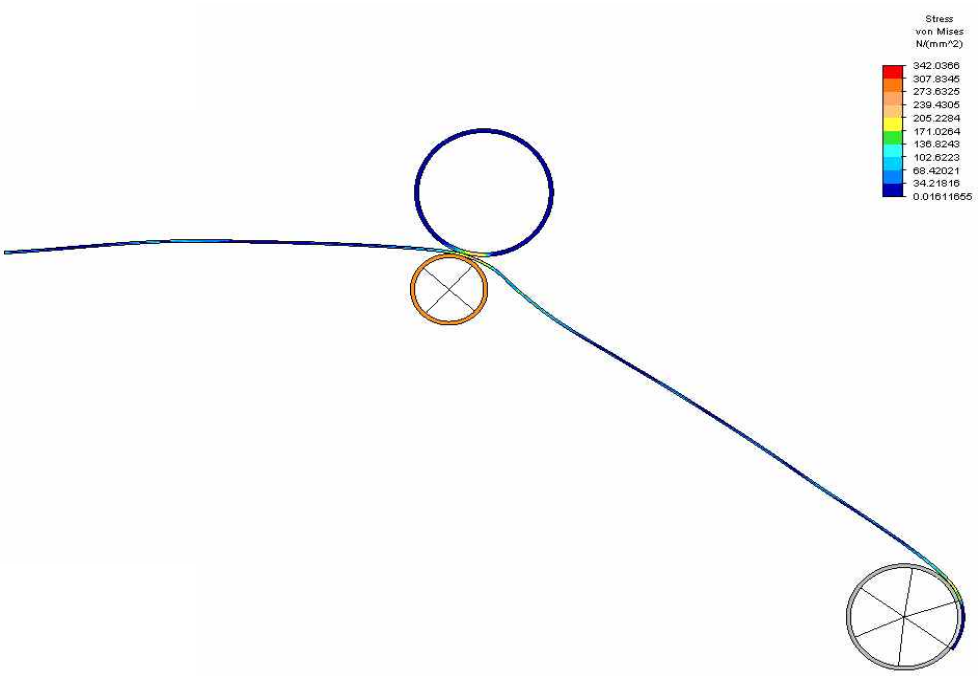


Pinching Force의 변화에 따른 권취 Torque의 변화

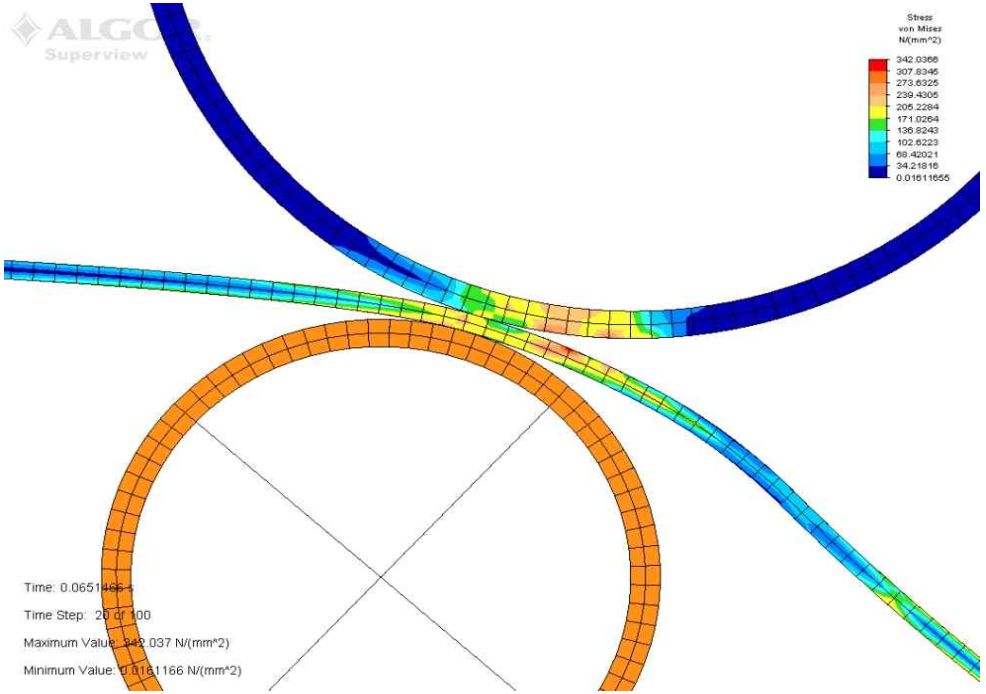


Pinching Force의 변화에 따른 Pinch roll 1의 반력

Pinching Force 변화에 따른 권취 Torque 평가



응력 분포



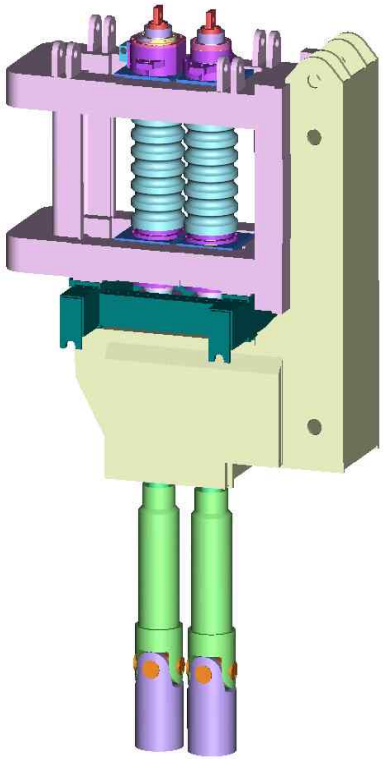
2선재공장 조압연 Mill 베어링 파손원인분석

- 목적 : 선재용 조압연기의 작업 중 베어링 파손 문제의 원인 규명

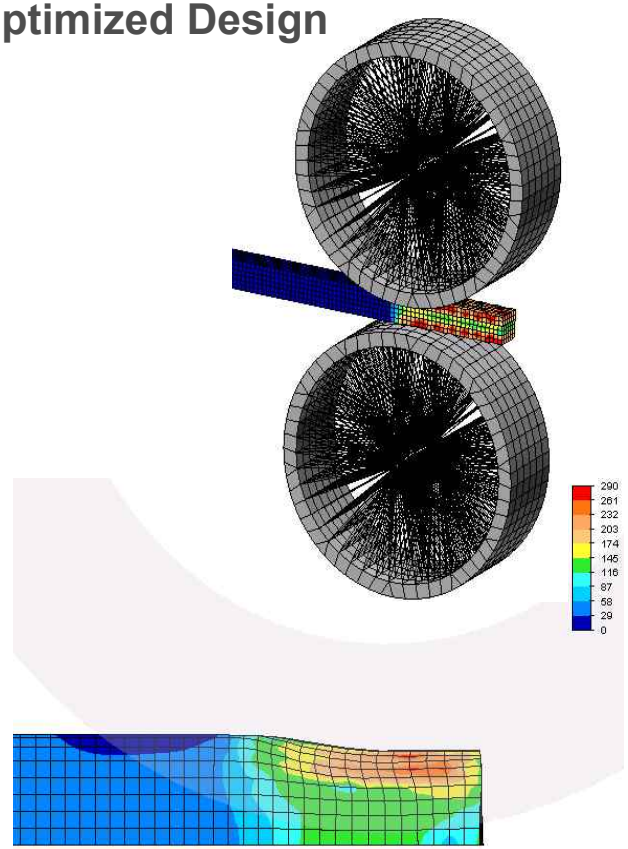
▶ **Determination of Rolling Force through MES**

▶ **Failure Analysis of Roller Bearing**

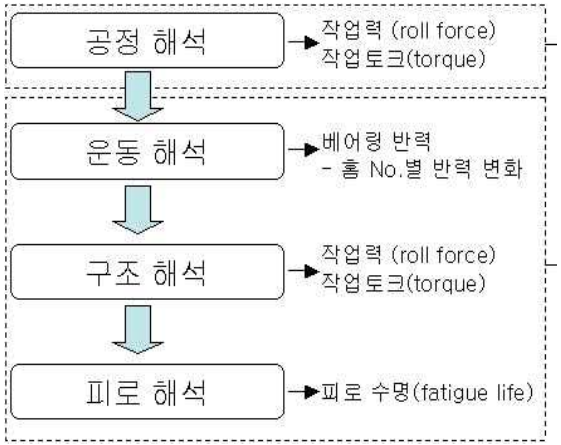
▶ **Suggestion of Final Optimized Design**

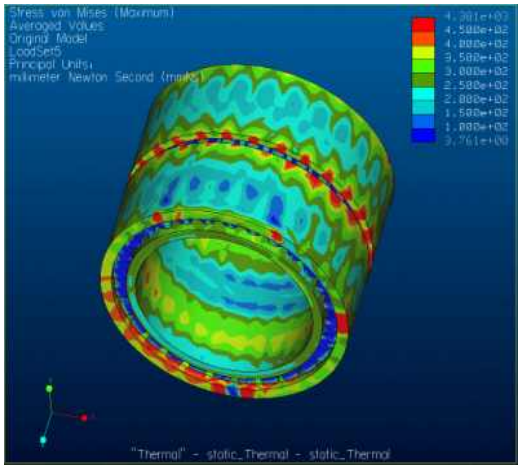


3D CAD Model



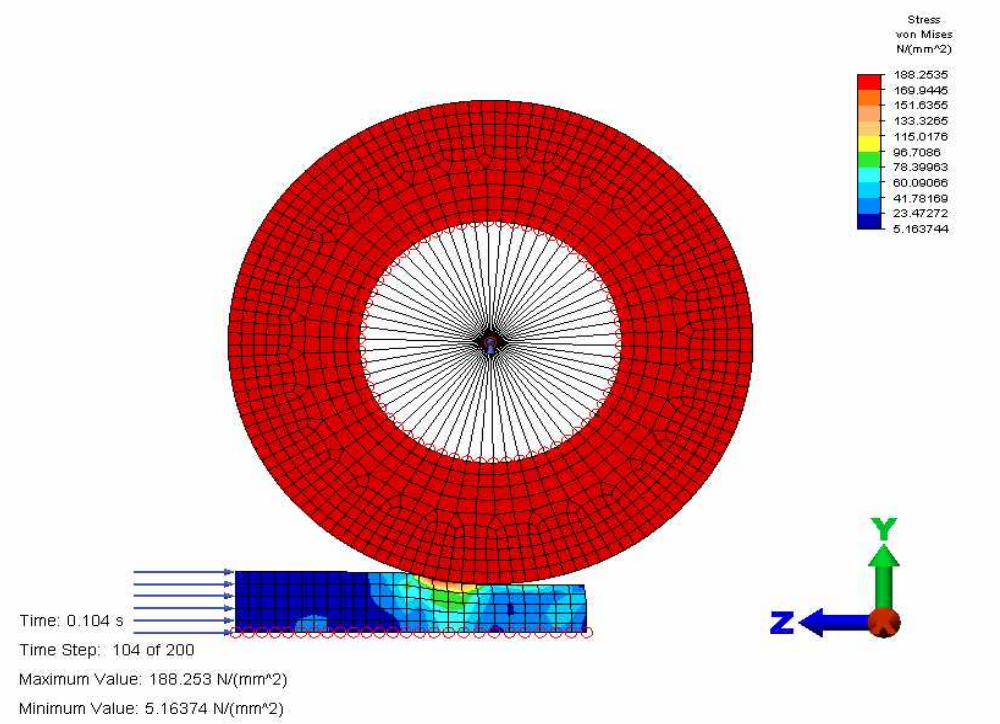
MES(Flexible Body Analysis)

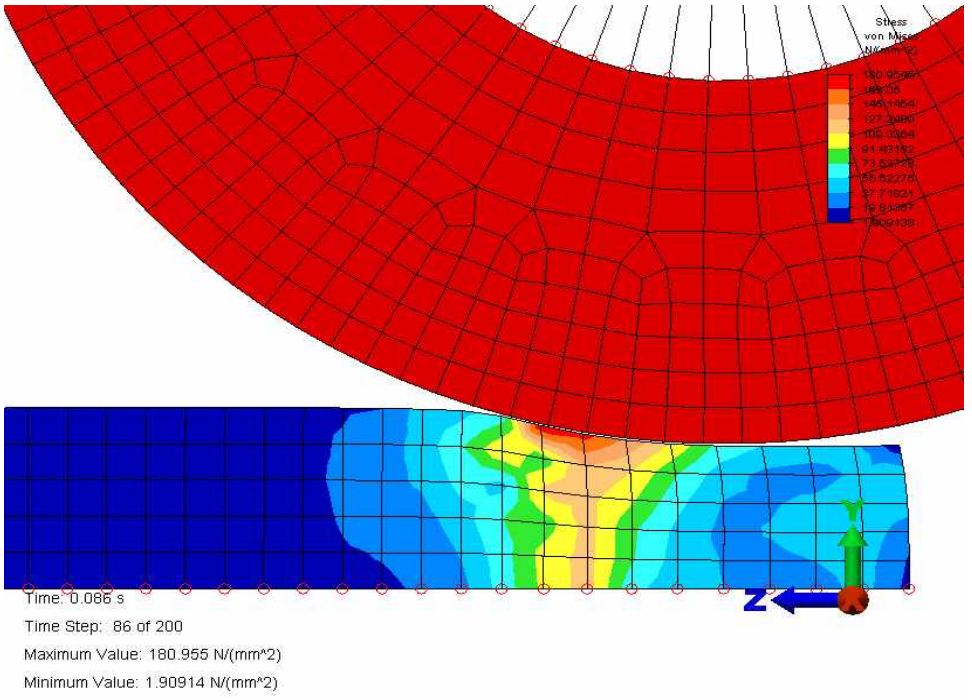




결과분석 및 개선안 도출

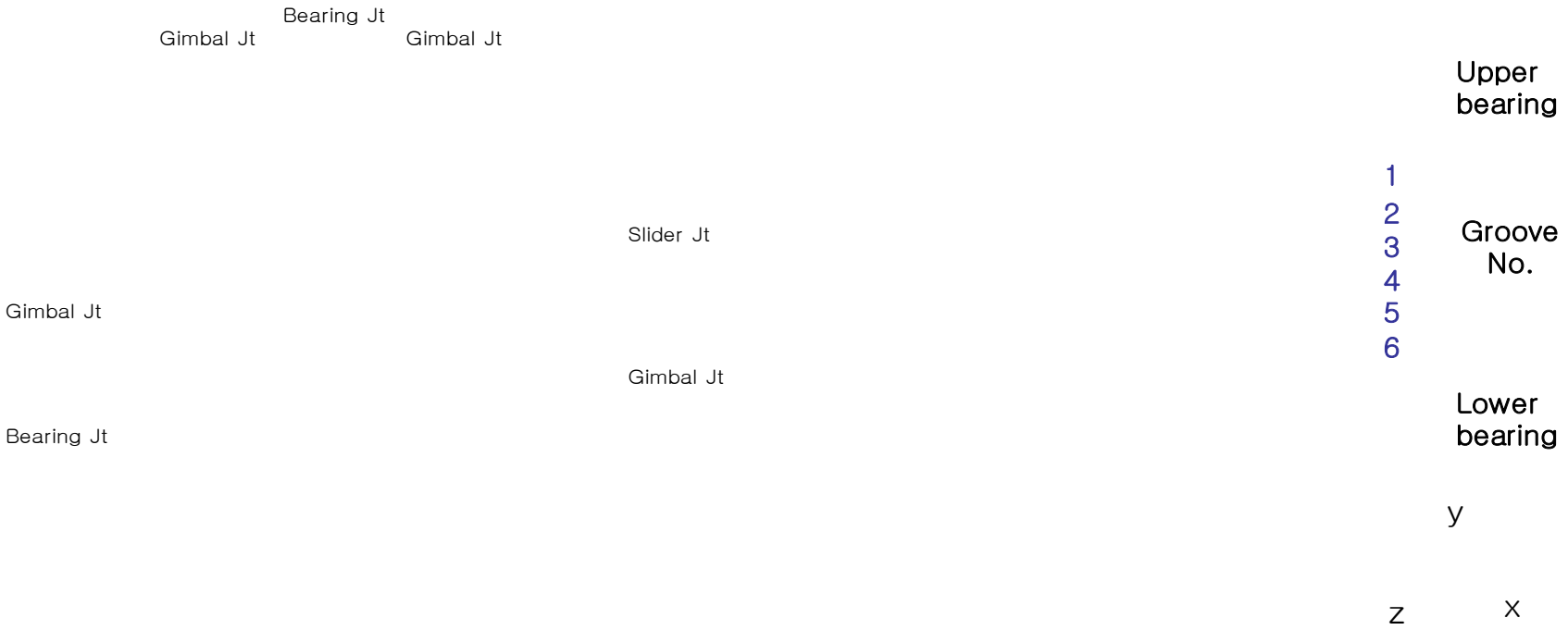
2선재공장 조압연 Mill 베어링 파손원인분석





2선재공장 조압연 Mill 베어링 파손원인분석

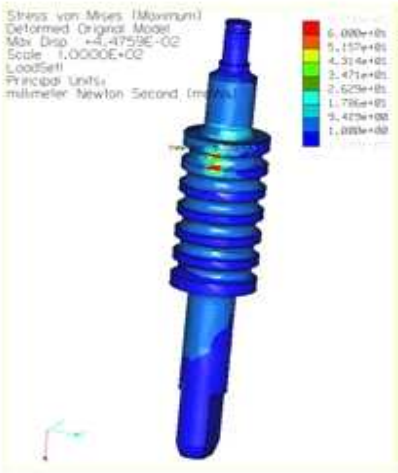
■ 동역학 해석

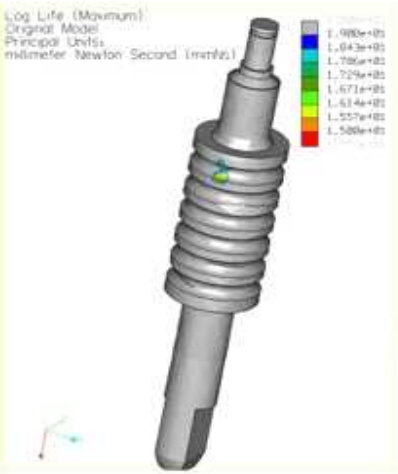


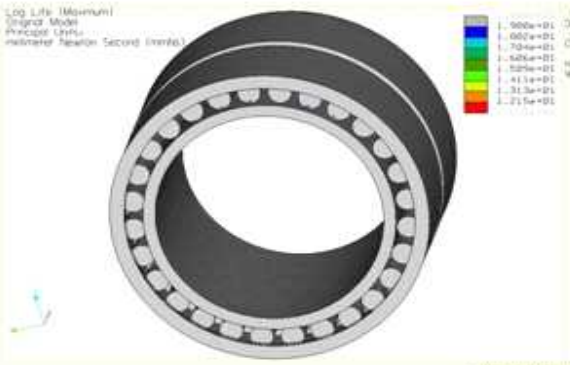
온도(℃)	Load (kN)	Groove No.					
		1	2	3	4	5	6
900	Fu_y	Fu = Upper bearing의 반력 Fl = Lower bearing의 반력					
	Fl_y						
	Fu_z						
	Fl_z						

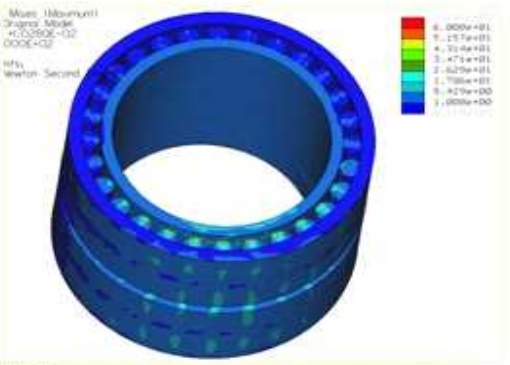
2선재공장 조압연 Mill 베어링 파손원인분석

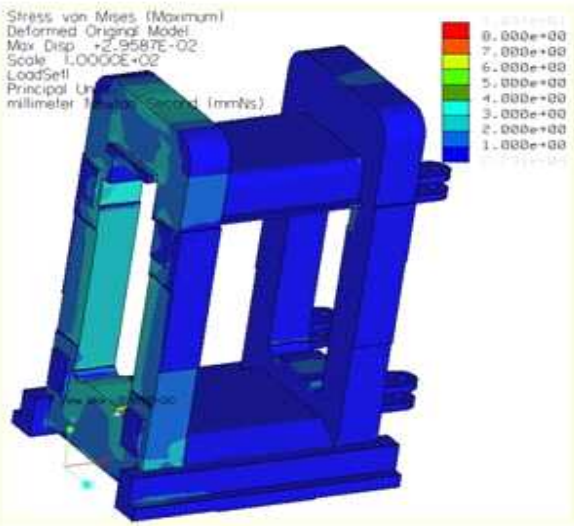
- 구조 및 피로 해석

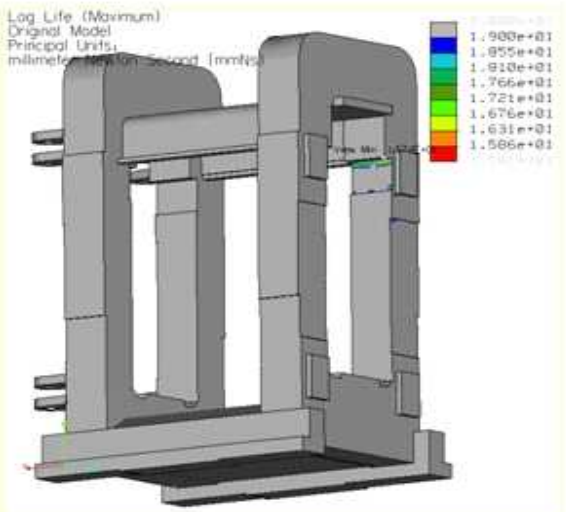


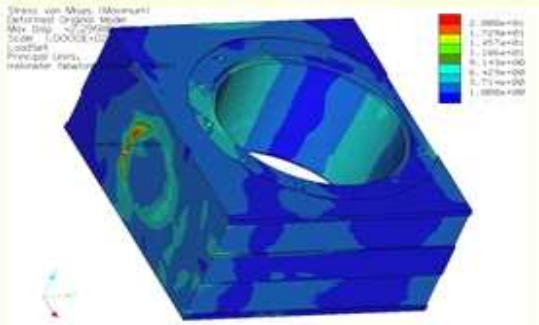


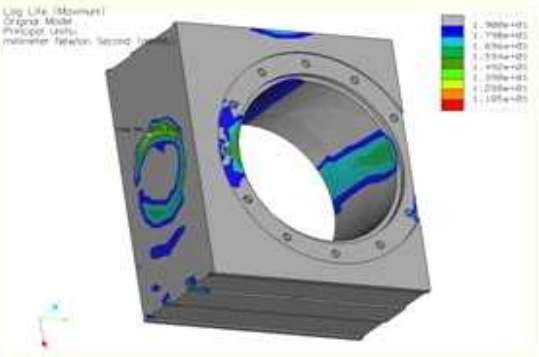






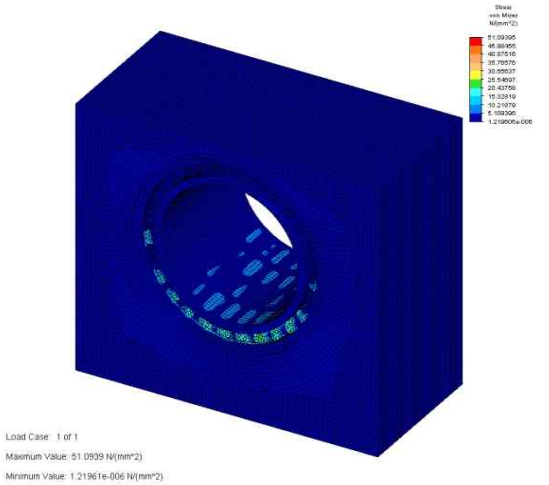




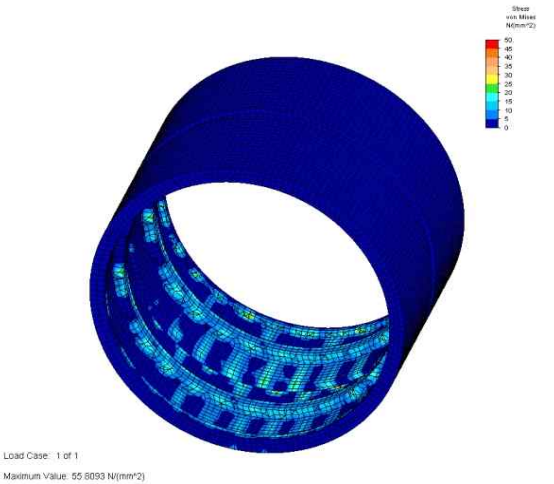


2선재공장 조압연 Mill 베어링 파손원인분석

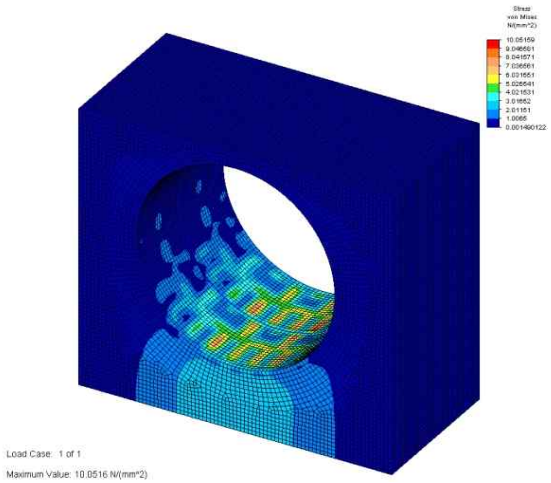
- 엄밀해석



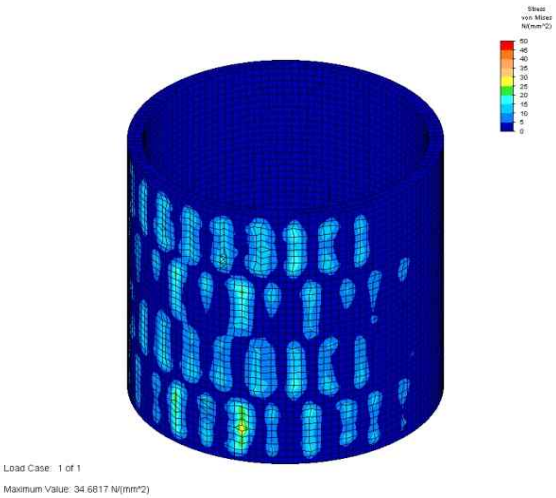
Assembly 모델 응력



Outer race 응력



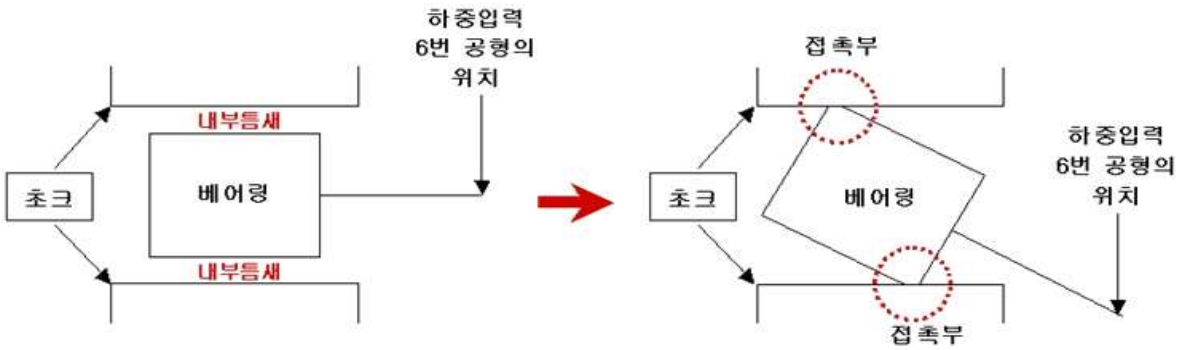
Chock부 응력



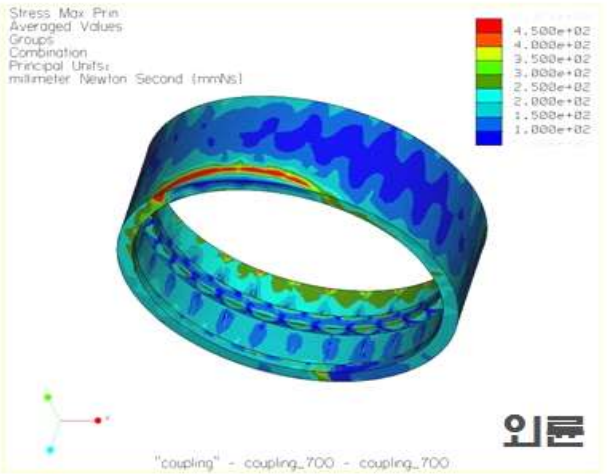
Inner race 응력

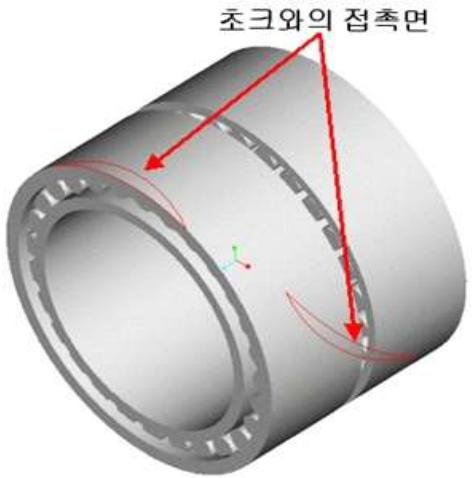
2선재공장 조압연 Mill 베어링 파손원인분석

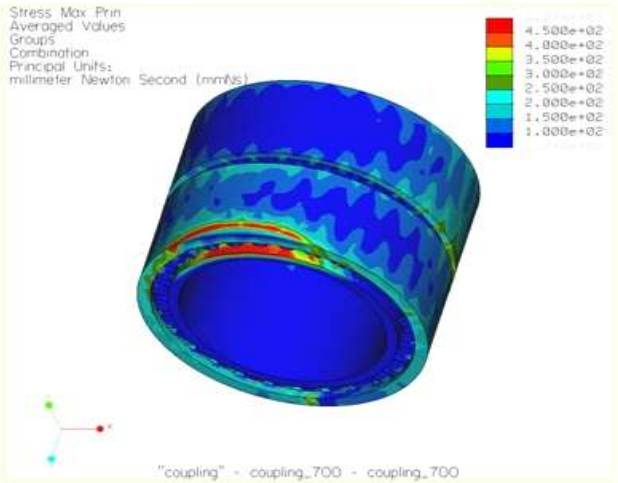
- 이상 상태 조건에 대한 해석

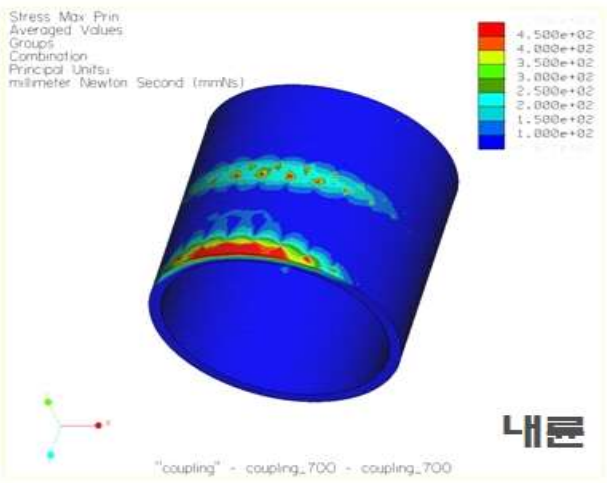


하중(kN)	Upper Bearing	Lower Bearing



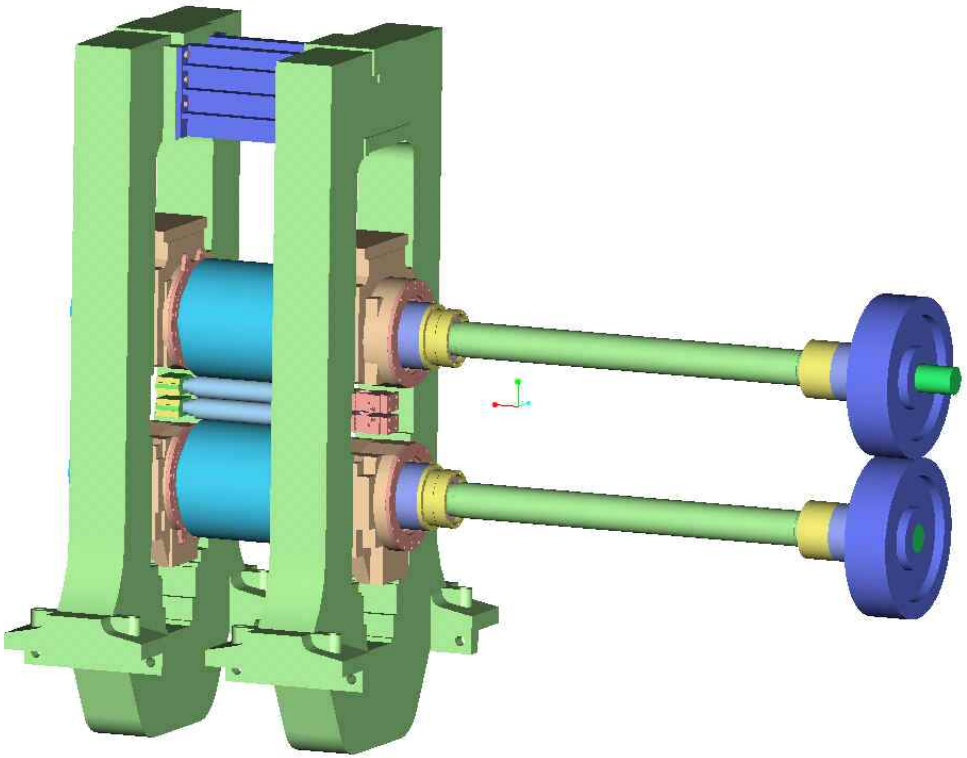


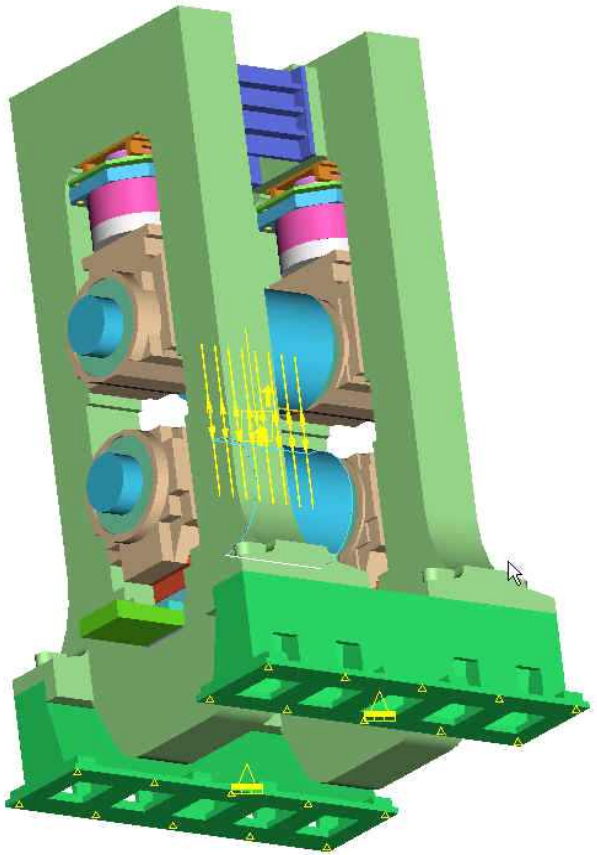




전기강판 CVC MILL 모델링 및 해석

- 목적 : 전기강판 CVC MILL의 삼차원 모델 구축 및 구조적 안전성 검토

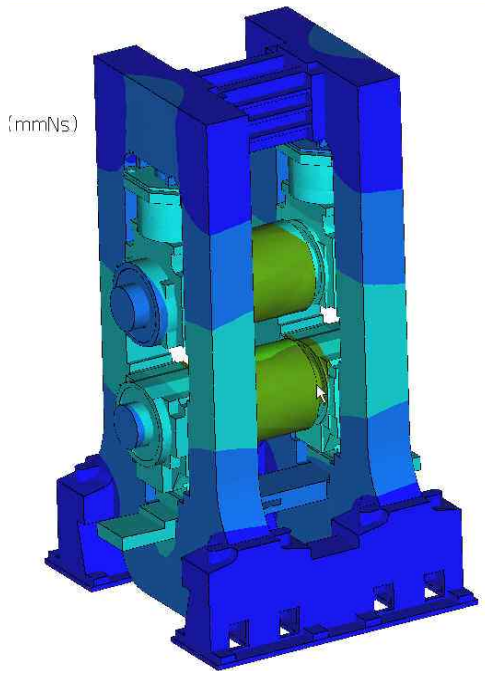




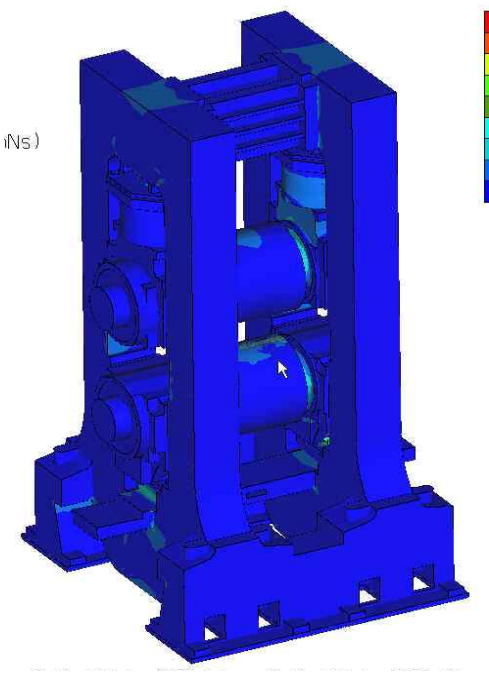
3차원 모델

전기강판 CVC MILL 모델링 및 해석

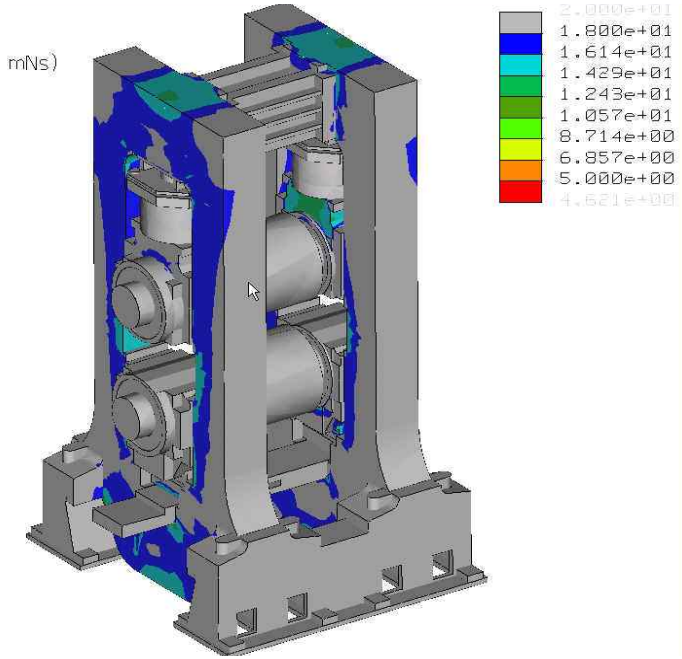
- 구조/피로 해석



변위



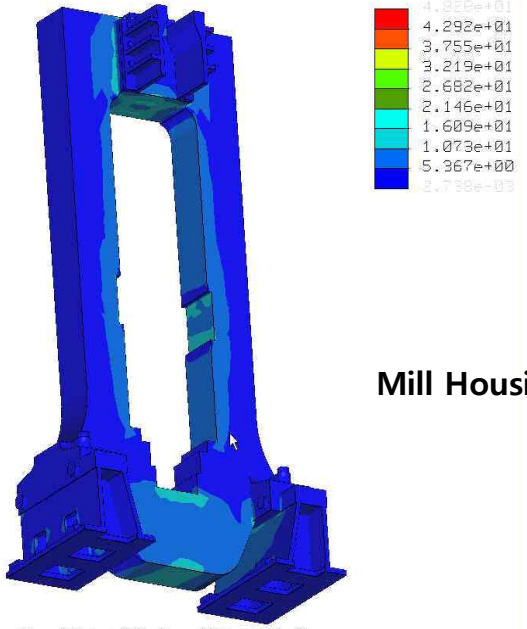
응력



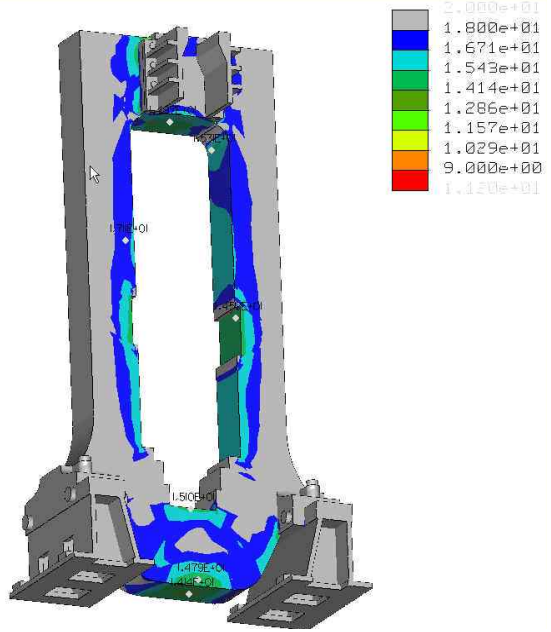
피로수명

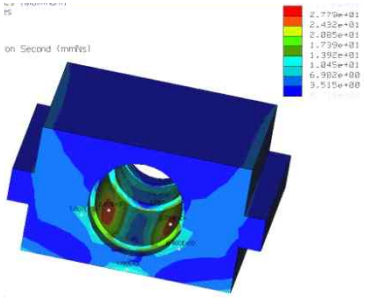
전기강판 CVC MILL 모델링 및 해석(계속)

- 구조/피로해석

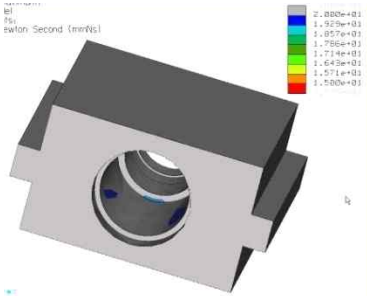


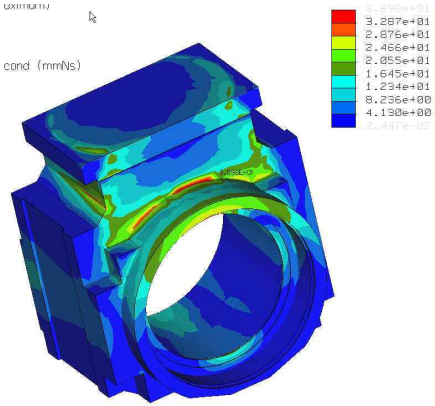
Mill Housing

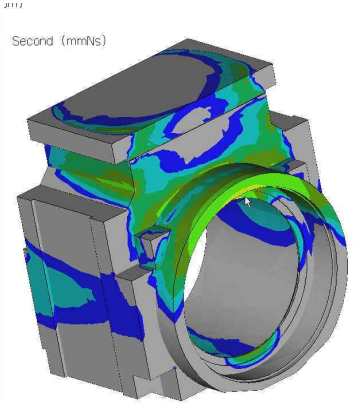




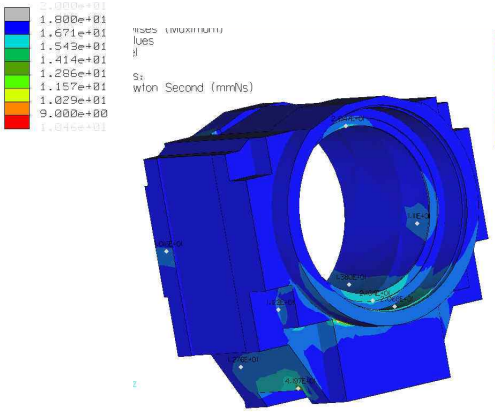
Work Roll Chock

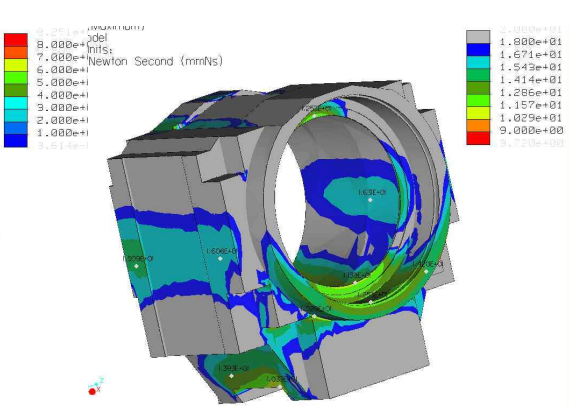






Backup Roll Chock - Up

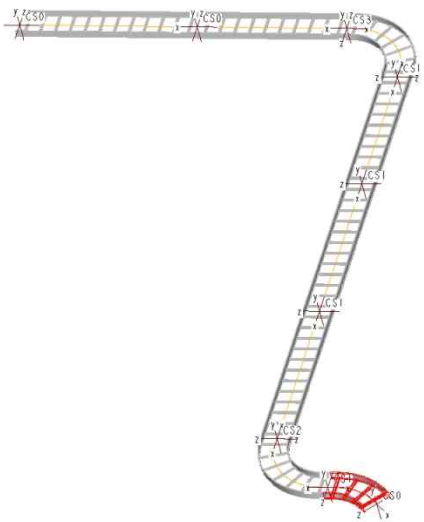




Backup Roll Chock - Down

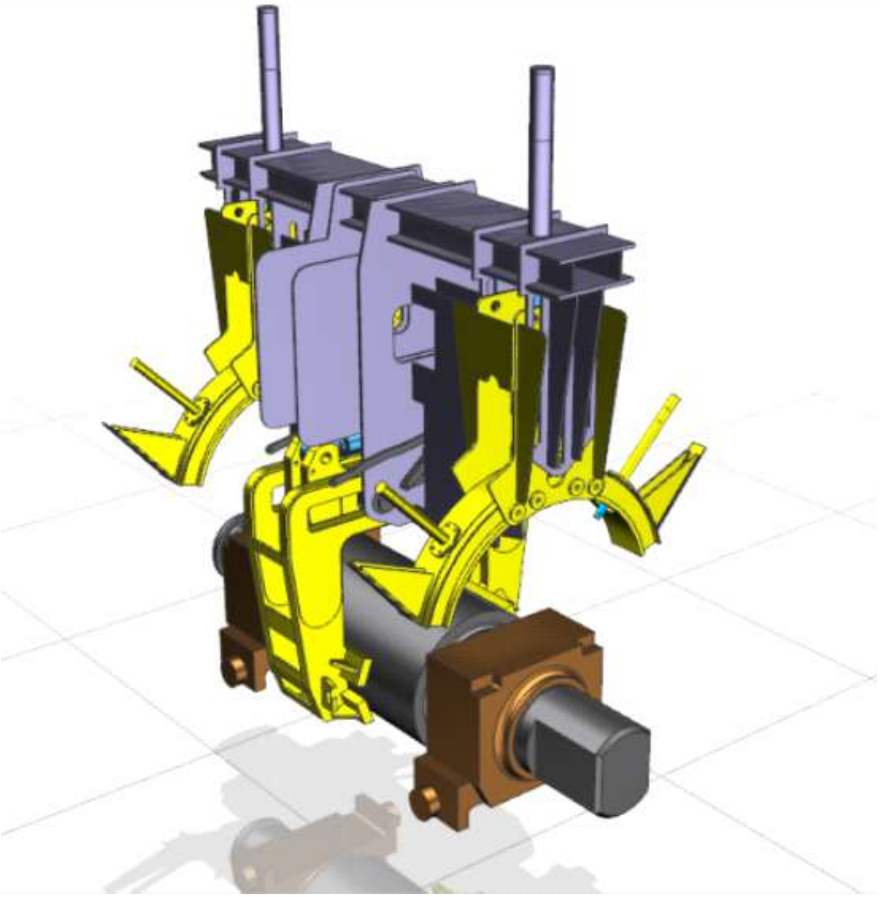
3차원 케이블 트레이 설계 프로그램 구축

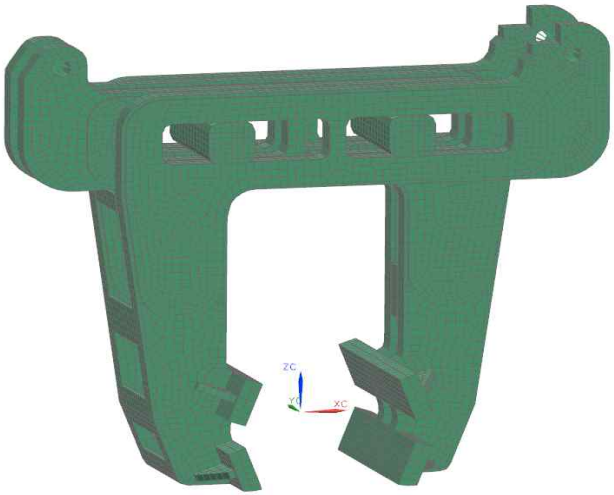
- 라이브러리 구축 -> 구축된 라이브러리를 이용하여 3차원 모델을 구성
- 장점 :
  - ✓ 간섭 체크(트레이 & 건물 & 설치 물)
  - ✓ 예상 소요 물량 산출
  - ✓ 전체 무게 산출
  - ✓ 예산 견적 산출
  - ✓ 설계 변경 시 신속 대응 방법을 강구



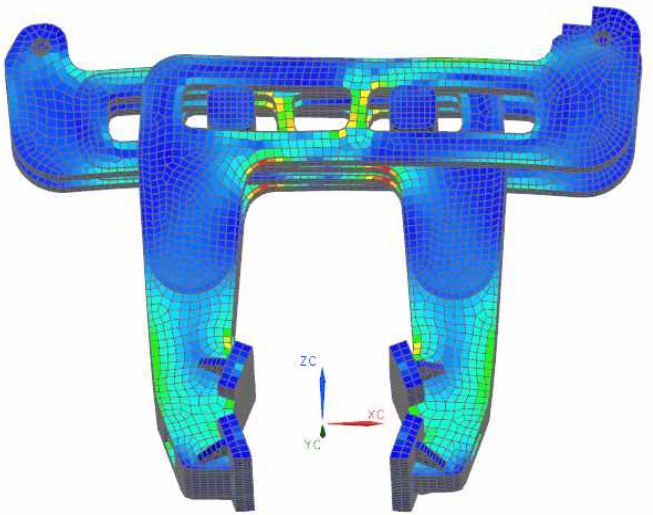
60TON ROLL TONGS

- 60ton work roll tongs의 구조적 안전성 검토 및 작동성 검토





해석 모델

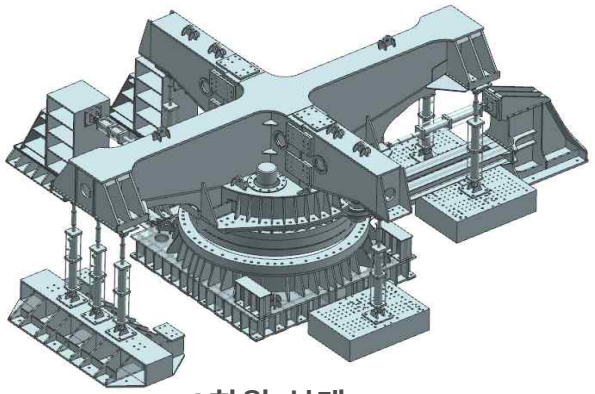


해석 결과

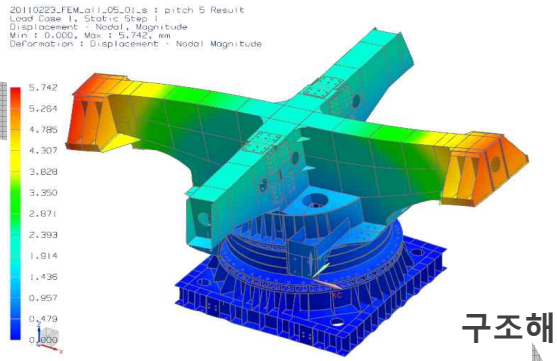
3MW급 풍력용 Bearing(Yaw/Pitch) 시험장비 개발

- 풍력발전기는 20년 이상의 내구수명을 확보해야 한다. 이 시험을 위한 3MW급 풍력발전기용 Yaw/Pitch Bearing의 시험 장비를 국내 최초로 개발하였으며, 현재 한국기계연구원에서 운영 중 이다.
- 가력기 용량 : 엑츄에이터 200ton~300ton

Concept Design



3차원 설계



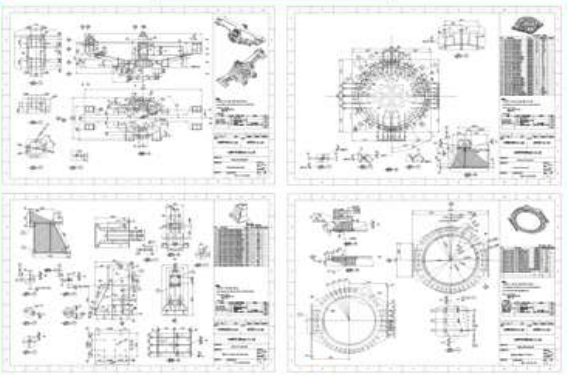
구조해석

베어링시험장비 개발

설치 및 시운전

검사

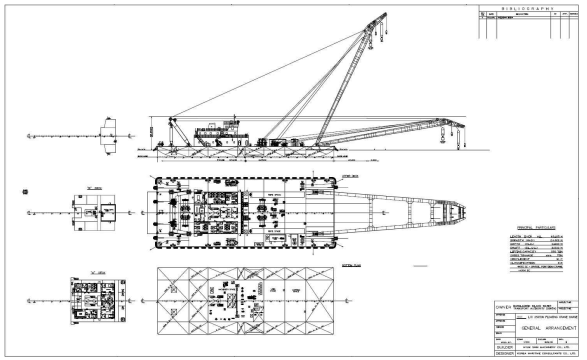
제작

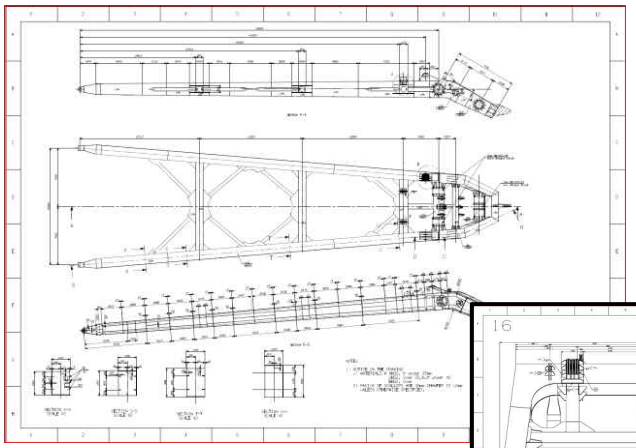


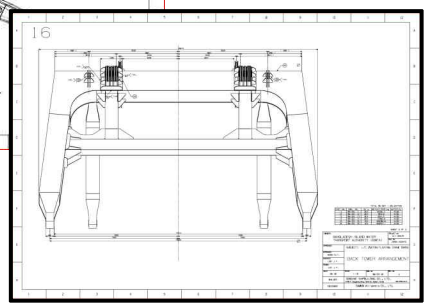
도면

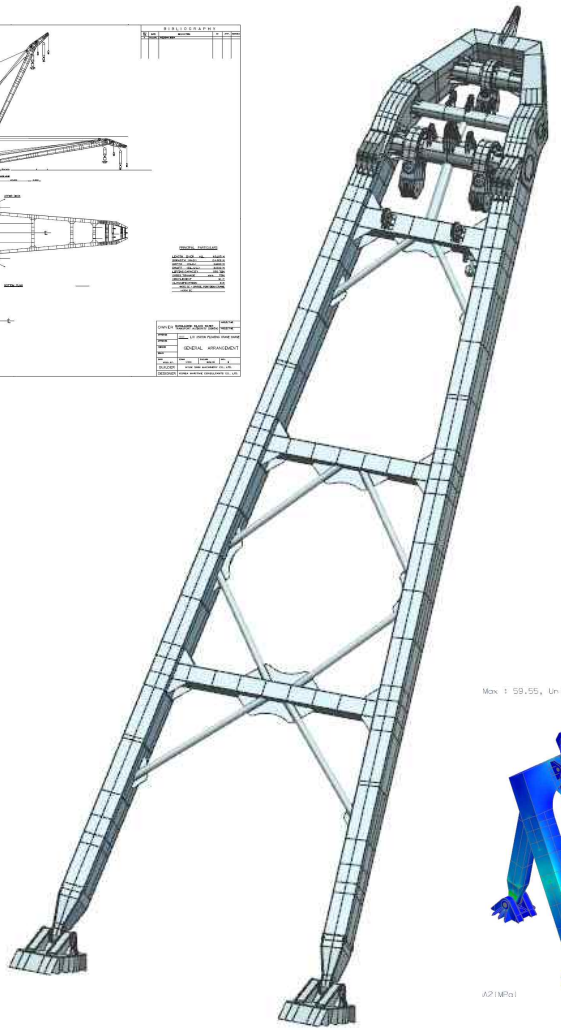
250ton Crane 개발

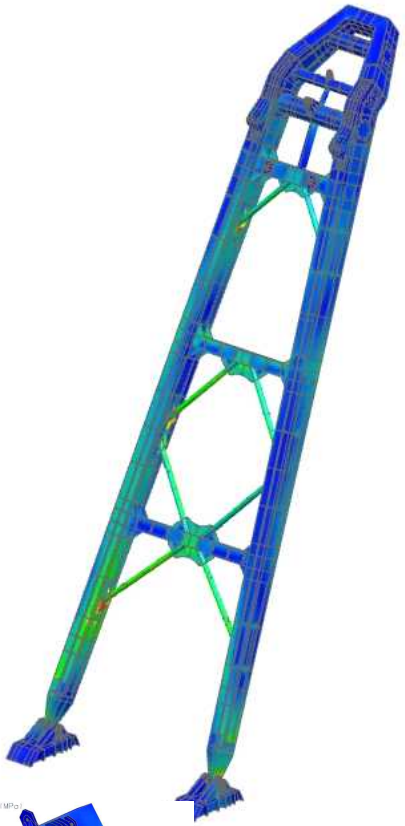
●현재, 크레인 설계에 주로 2D 설계와 수 계산을 이용한 설계가 주로 이루어지고 있다.
●3차원 설계와 해석 기술, 생산을 고려하여 250ton Floating Crane 개발하였다.

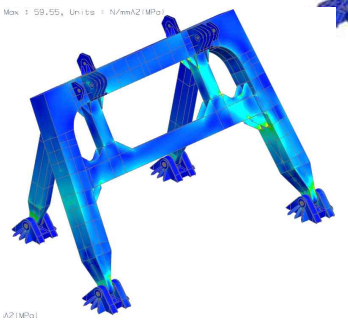








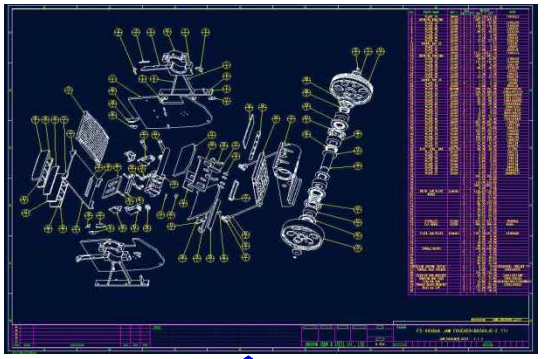




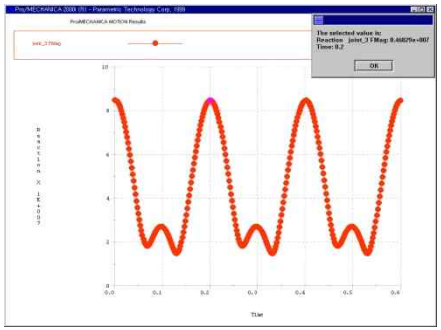
파쇄기(JAW Crusher) 개발

●외국 도면을 수입하여 국내에서 제작하는 제품의 **설계 국산화**을 통하여 독자 설계 기술 확보,
년간 10억 절감의 효과를 거두었다.

3D CAD 설계 ▶ 동역학 및 구조해석 ▶ 도면 & BOM



년 10억 절감
독 자 설 계

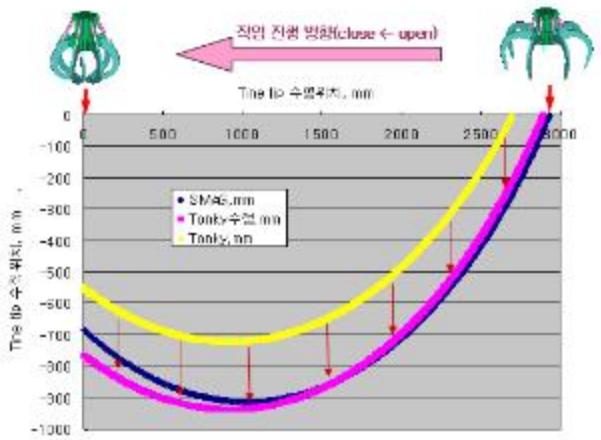


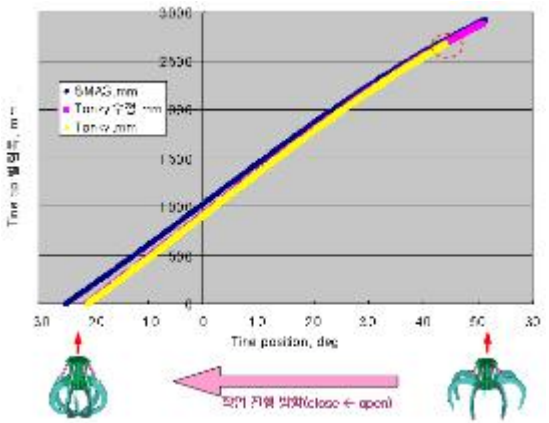
파쇄기(Jaw Crusher) 개발

- 동 시 공 학
- 설계 자료 확보

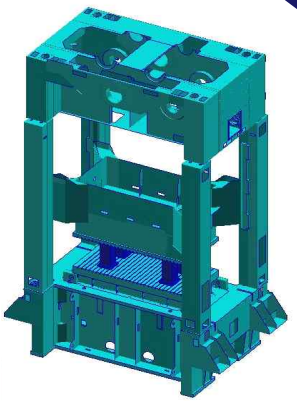
Grab 개발

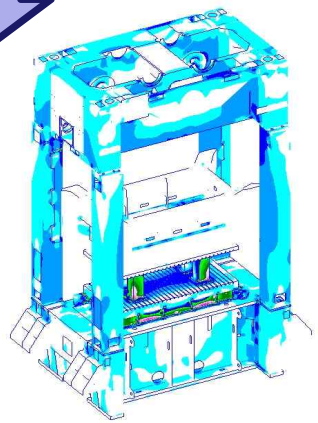
- Grab 작업 성능에 영향을 주는 인자를 찾고 작업 성능이 개선된 새로운 모델의 개발
- 이를 위하여 3차원 설계 및 동역학 해석 기술을 이용하였다





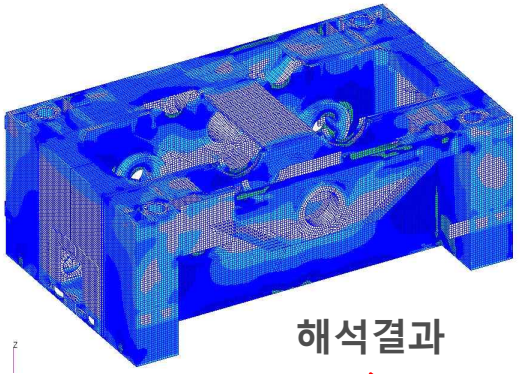
2400톤 프레스 해석 프로세스 정립





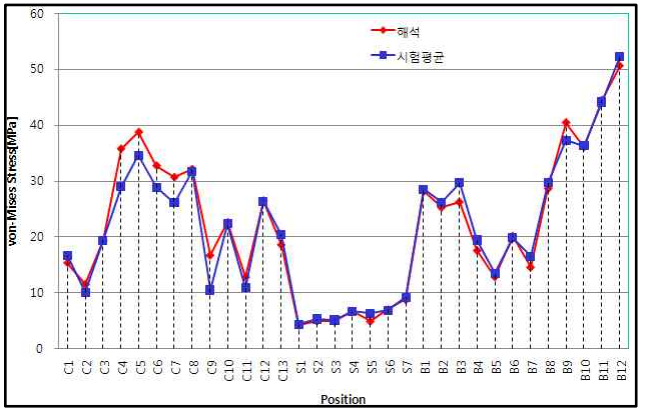
3D model

구조해석



해석결과

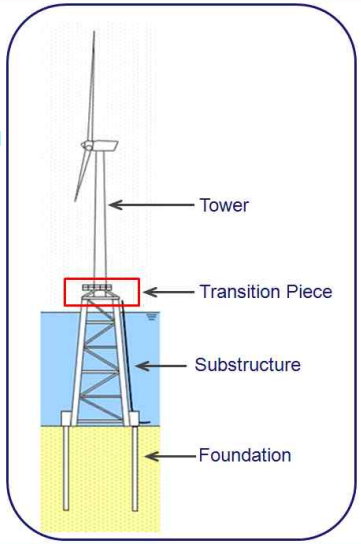
시험결과

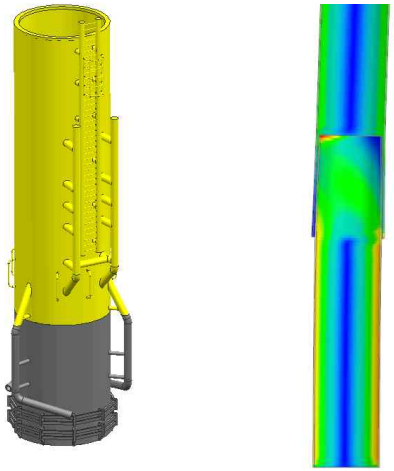


- 회귀분석을 통하여 해석 결과와 시험 결과의 오차를 검토
- 하중입력 방식 및 구속조건 입력 방식에 대한 구조해석 신뢰성 검증
- 해석기법 정립

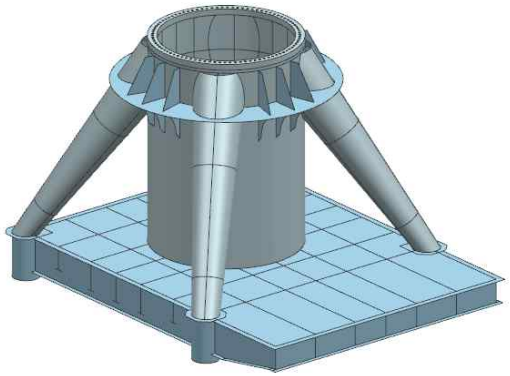
5MW 해상 풍력 발전기 Transition Piece 개발

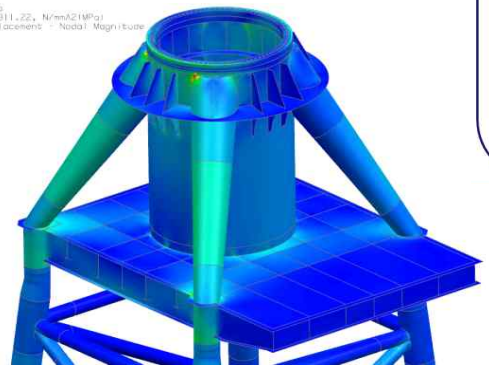
- 목적 : 5MW 해상 풍력 발전기용 Transition Piece 설계 및 경제성 분석
  - Monopile Type, Jacket Type, Tripile Type, Dolphin Type



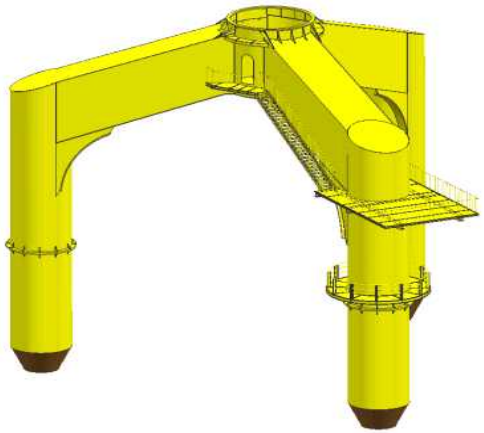


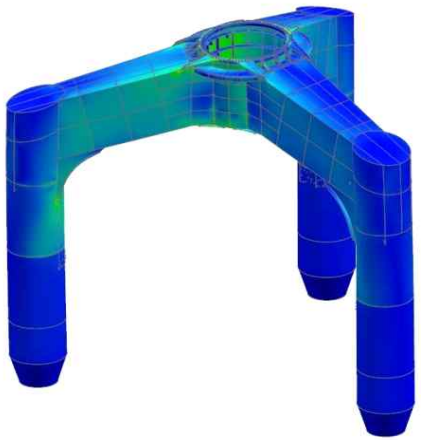
Monopile type



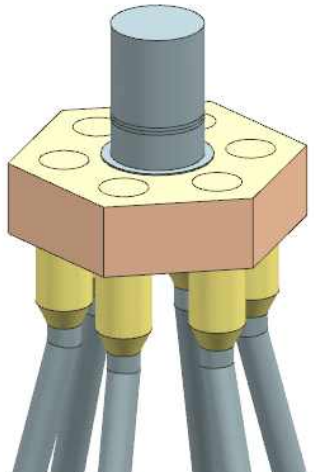


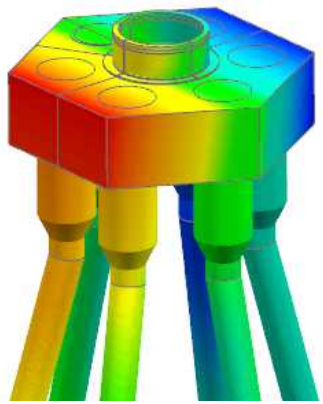
Jacket type





Tripile type

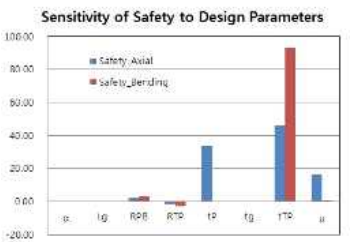


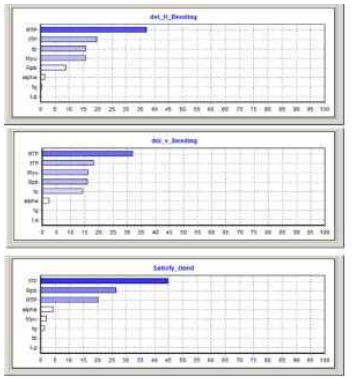


Dolphin type

5MW 해상 풍력 발전기 Transition Piece 개발

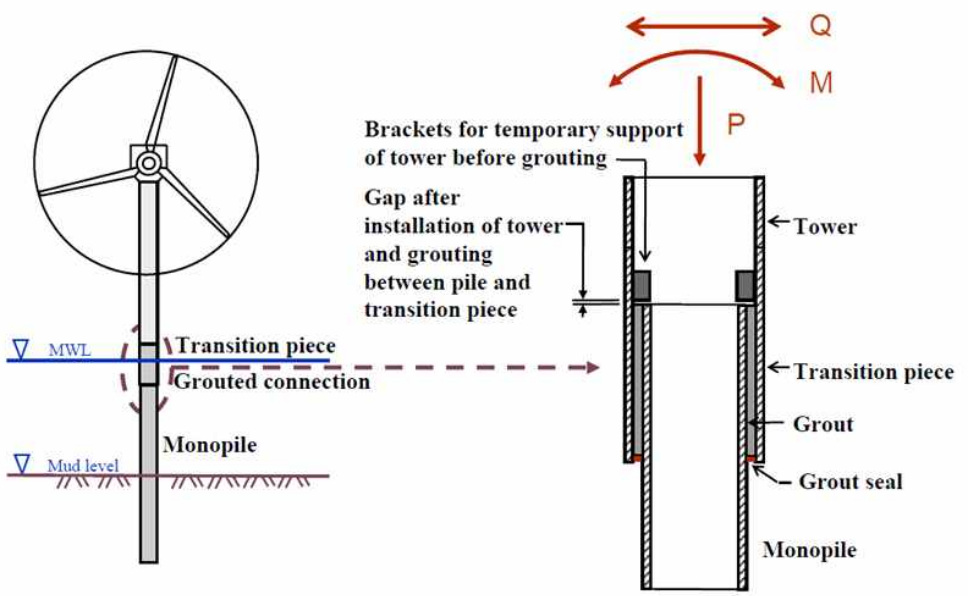
- 최적설계 기법을 적용하므로 중량이 감소한 강건한 제품을 설계할 수 있으며, Monopile Type과 Jacket Type에 적용한 사례이다.





❖ Monopile Type Transition Piece

- 설계 민감도 해석 및 최적 설계 기법 적용 :
  - **민감도** - Individual Input Parameters
  - ✓ - 실험계획법



Grouted connection in monopile structure

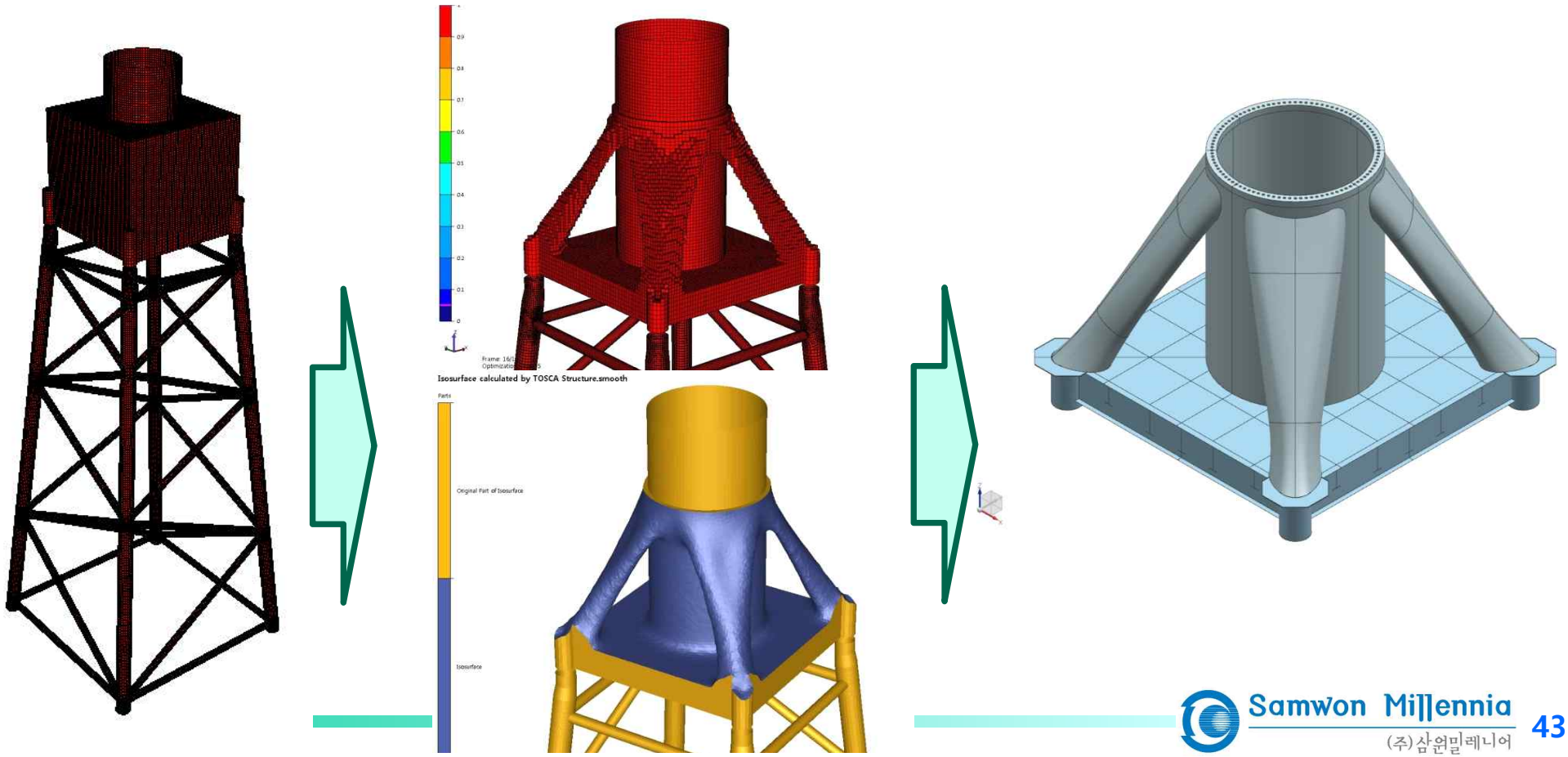
목적함수 : Minimize Mass of monopile
설계 변수 : α, Rpb, t_p, t_{tp}
제한조건 : Safety for Axial Capacity(SAC)
: 30<SAC(%)<60
Safety for Bending moment Capacity(SBC)
: 25<SBC(%)<60
1<α(deg)<2, 2<Rpb(m)<3, 0.05< t_p(m)<0.09,
0.05<t_{tp}(m)<0.08

Parameters			Initial(%)	Optimal(%)
Design Variables	α	deg	100	0.0
	Rpb	m	100	-2.9
	tp	m	100	-21.9
	t_{TP}	m	100	0.0
Objective Functions	Mpile	ton	100	-24.2
	Mgrout	ton	100	-3.0
	Mtp	ton	100	-3.0
Constraints	Satisfy_Axial	%	100	-23.4
	Satisfy_Bend	%	100	-10.0

5MW 해상 풍력 발전기 Transition Piece 개발

❖ Jacket Type Transition Piece

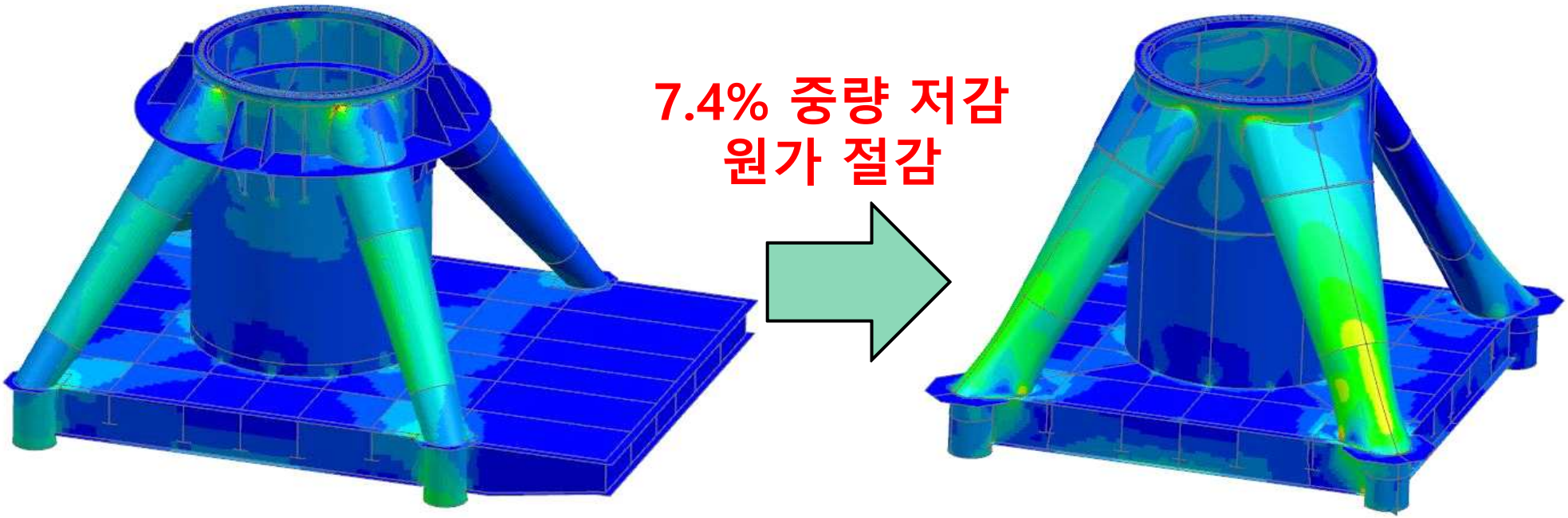
- ▪ 위상 최적화 및 형상 최적화 기법 적용
  - ✓위상 최적화 기법 : 초기 형상 설계(기본 설계)
  - ✓형상 최적화 기법 : 국부적인 응력 감소 ->피로 수명 증가



5MW 해상 풍력 발전기 Transition Piece 개발

❖ Jacket Type Transition Piece

- 기존의 방법으로 설계한 것과 최적화 기법을 이용하여 설계한 것의 응력 분포는 아래와 같으며 **중량은 7.4% 감소** 하였다.



(a) 기존 설계 방법을 이용한 Transition Piece

(b) 최적 설계 방법을 이용한 Transition Piece

감사합니다.

TEL 031-714-3349, FAX 031-714-3550

E-mail : cae@cae.co.kr