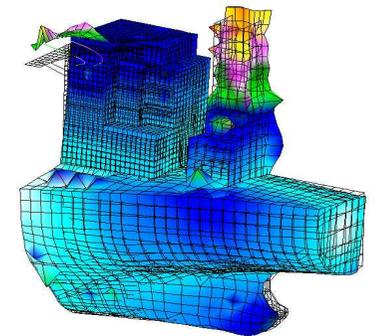
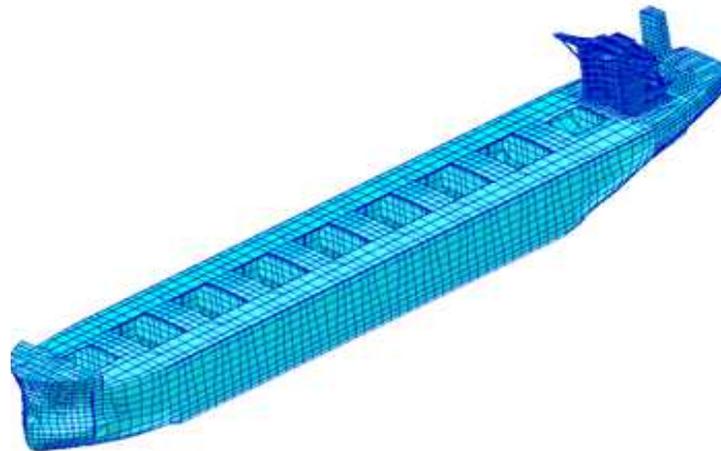
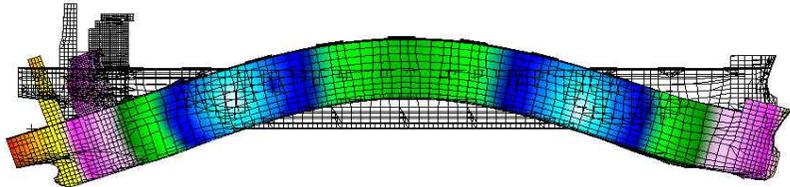


Hi, FEA

High Performance, Fast, Easy & Accurate

회사 소개서

(주)삼원밀레니어 (진동해석분야)



Samwon Millennia

(주)삼원밀레니어

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업 체 명	(주)삼원밀레니어	대 표 자	이 지 현
설 립 일 자	2001년 09월 14일	주 생 산 품	엔지니어링 서비스, 신재생에너지 설비 외
본 사 소 재 지	경기도 용인시 기흥구 중부대로 184, 기흥혁신유타워 A동 1607호		

※ 2011. 05 벤처기업 확인 (제20110102364호)

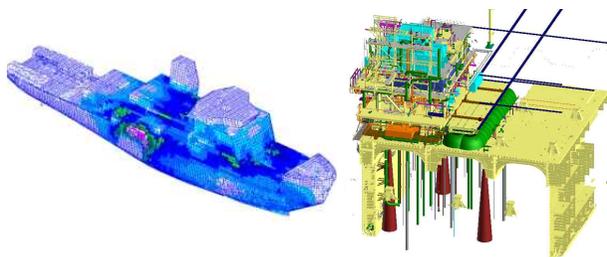
※ 2010. 04 이노비즈 확인 (제R7062-1449호)

※ 2002. 07 기술연구소 인정 (제20021972호)

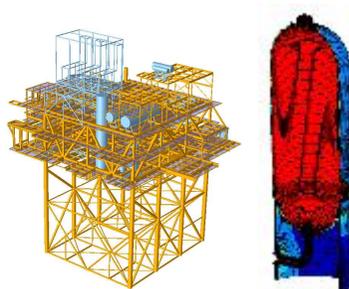
※ 2016. 04 청년 친화 강소기업 인증

※ 2020. 07 수출 유망 중소기업 지정

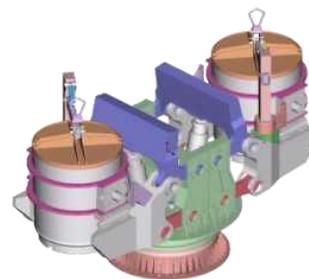
※ 2020. 11 일자리 창출 우수기업 인증



조선/해양



플랜트



제철설비

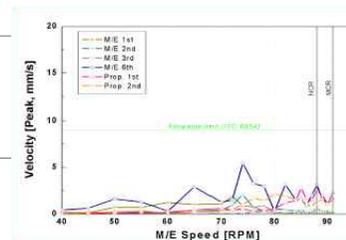
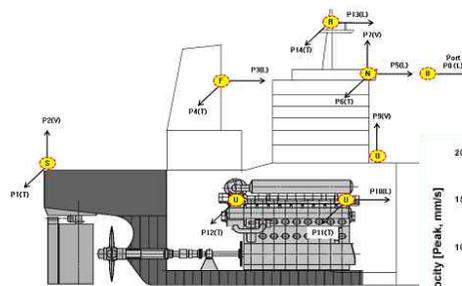
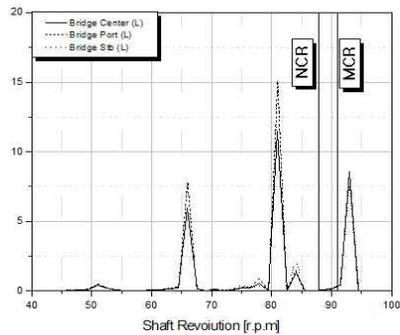
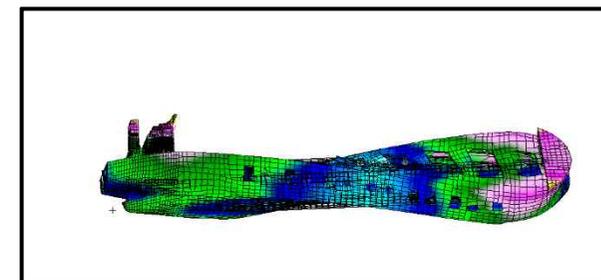
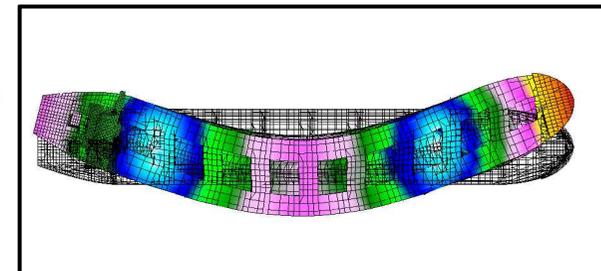
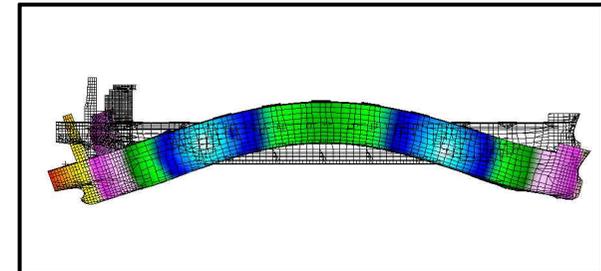
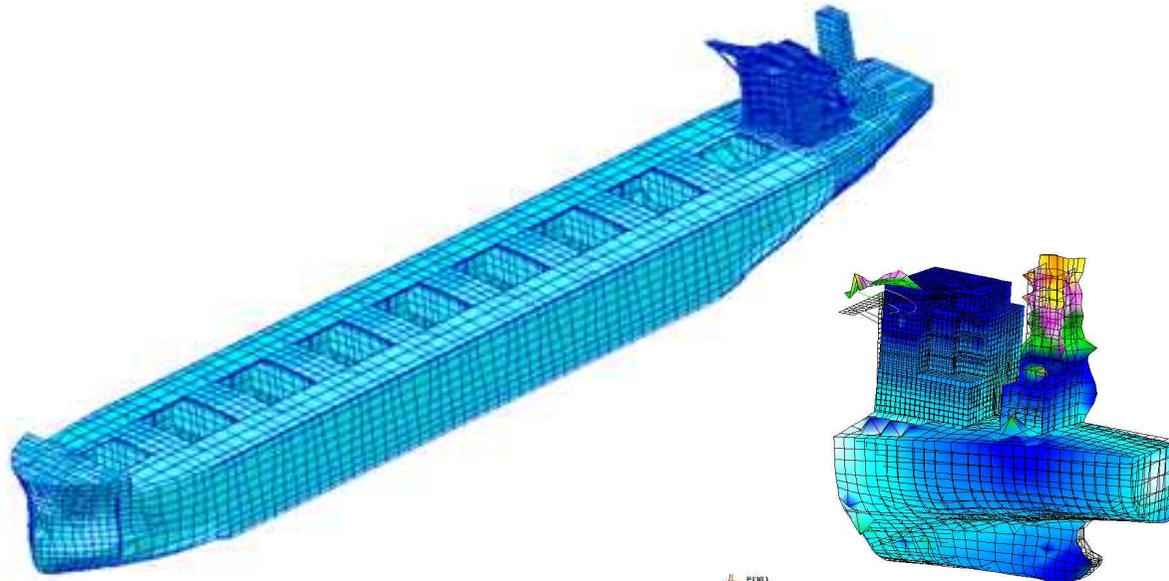


태양광 및 풍력 발전시스템



3. 진동 해석 분야 주요 실적

- 180K Bulk Carrier 전선 진동 해석 및 계측

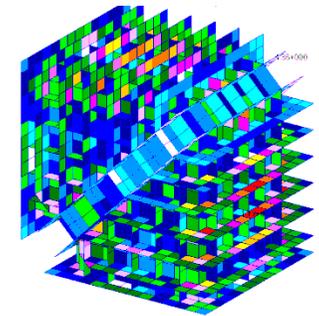
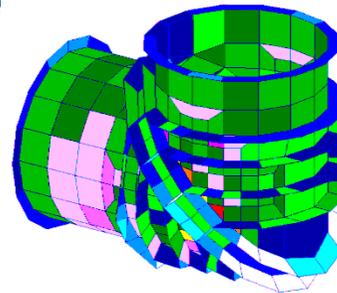
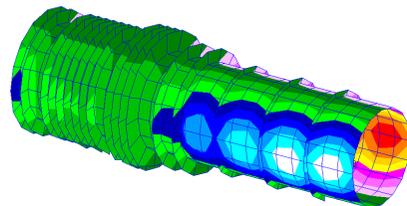
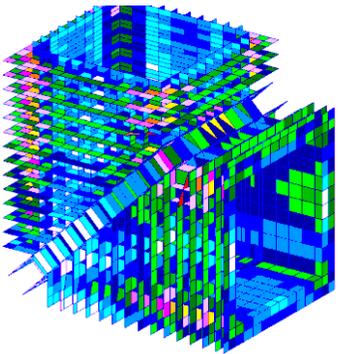
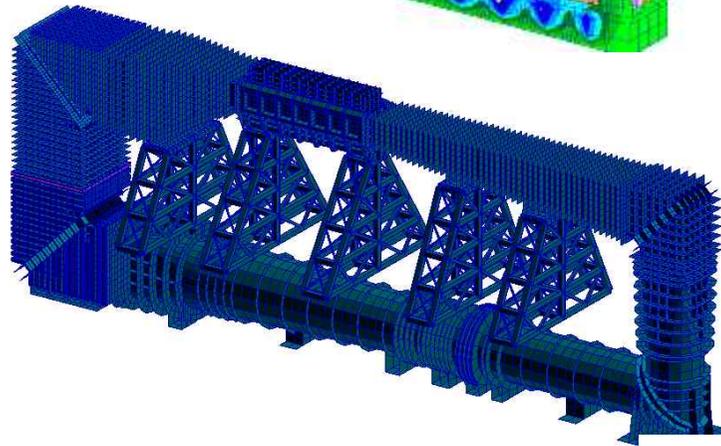
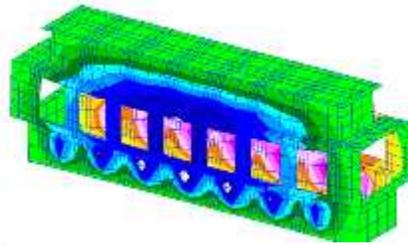
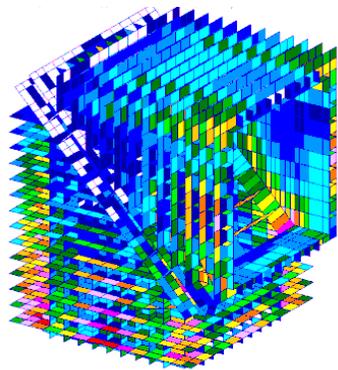


강제진동해석 결과

Global 진동계측

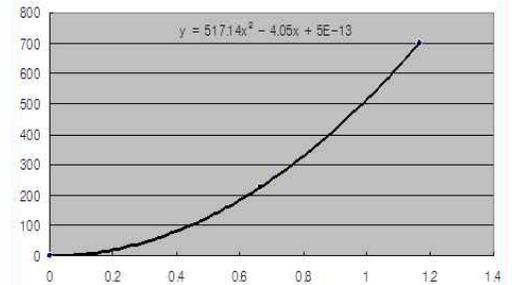
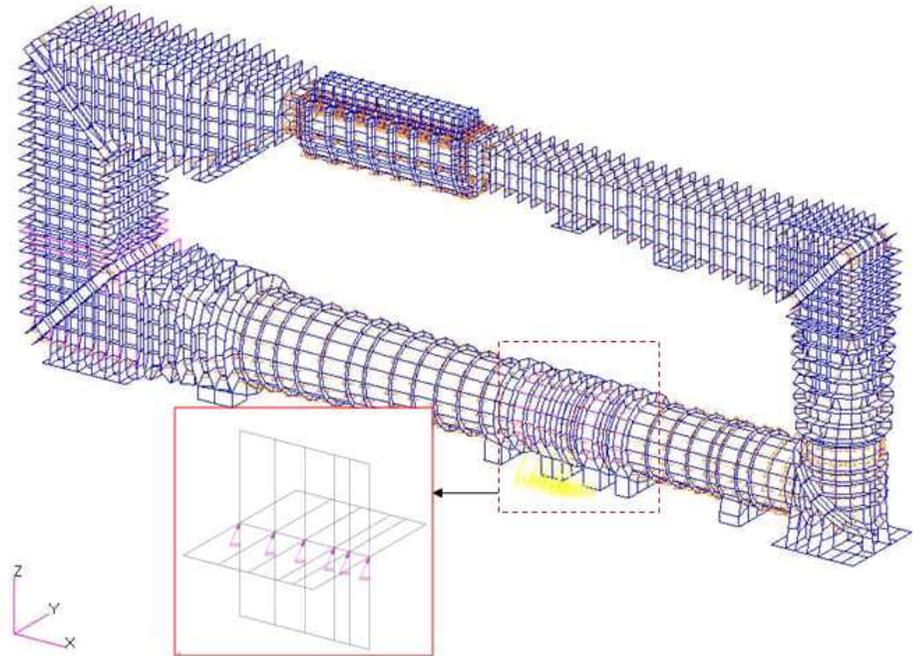
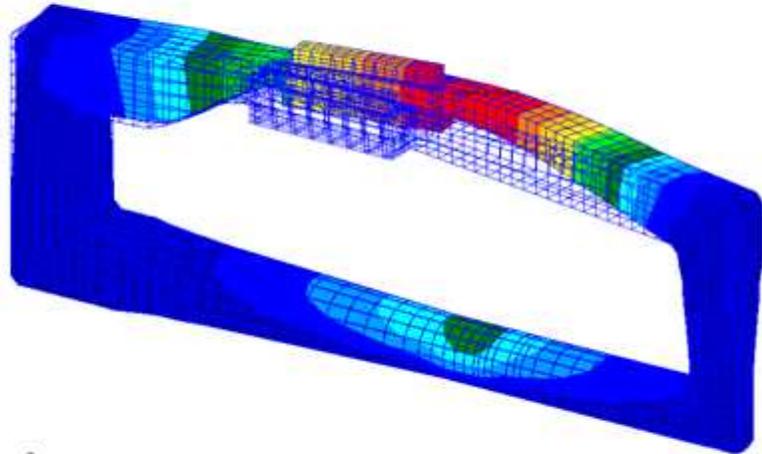
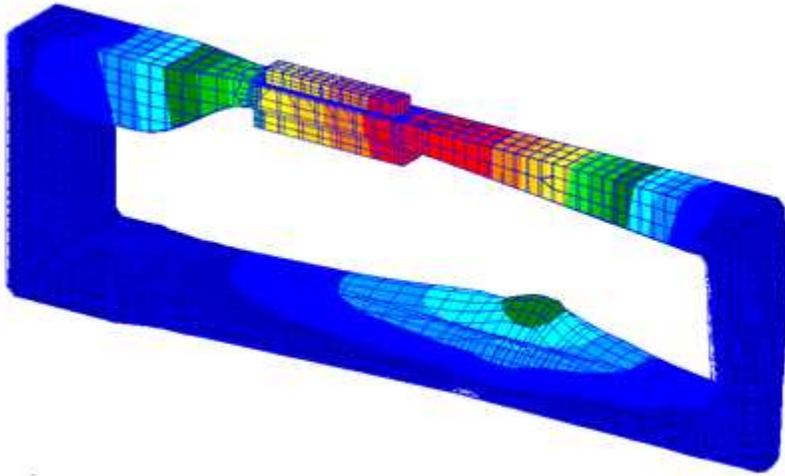
Global Analysis Mode Shape

- 저소음 대형 케비테이션 터널은 상선 및 특수선의 케비테이션 및 각종 유체시험, 소음계측 및 각종 수중 음향시험에 사용되며, 선박 개발에 활용된다.
- 국내 기술로 개발된 최초의 초대형 케비테이션 터널(길이 60m, 높이 22.5m, 폭 6.5m) 이며, 선박과 함정의 성능시험이 국내서도 가능하게 되었다.

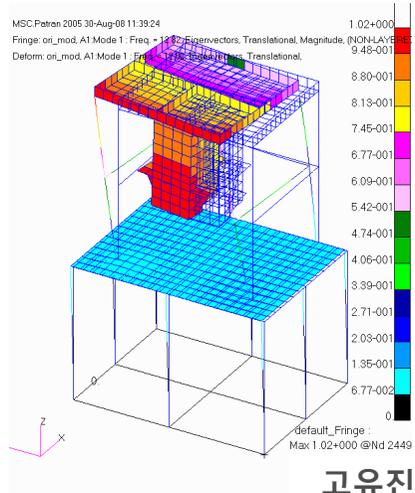


Max
Min

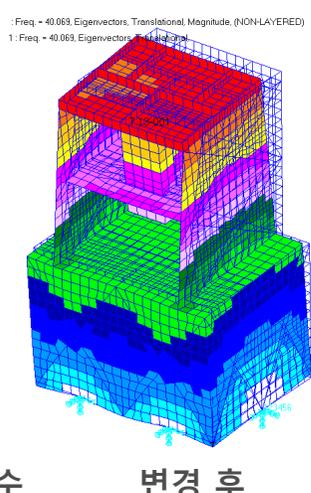
- 저소음 대형 Cavitation Tunnel 진동 해석



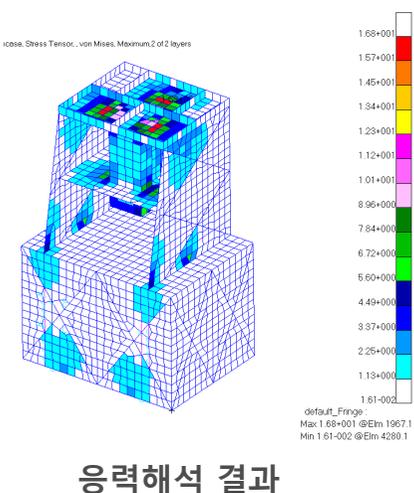
- 헬리콥터의 Actuator를 시험하기 위한 시험장치이며, 설계 조건은 아래와 같다.
 - A. 3개의 Actuator에 각각 5ton의 하중이 가해질때 구조물이 안정해야 한다.
 - B. 1차 고유진동수는 40Hz 이상이며, 진동특성을 고려하여 100Hz이하에서 구조물이 안전해야 한다.



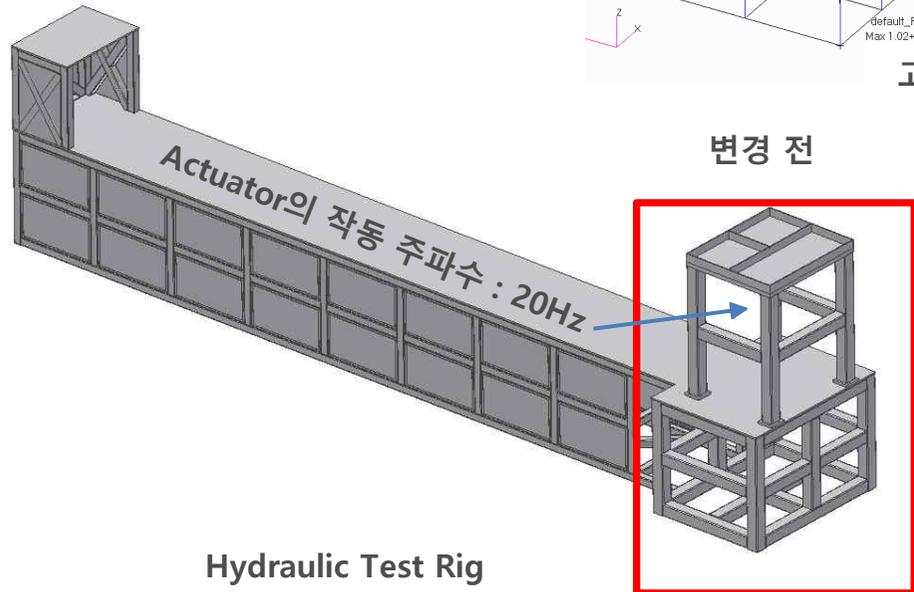
고유진동수



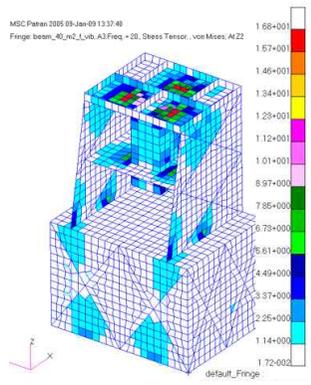
변경 후



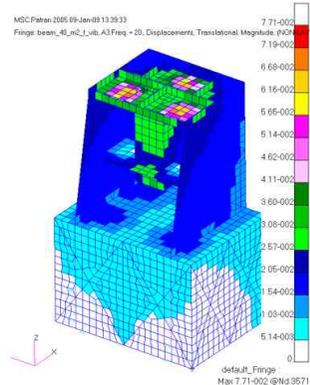
응력해석 결과



변경 전



주파수응답해석 결과



- 20kW 소형 풍력발전기 타워 진동해석



1차 모드

2차 모드

3차 모드

GL Guideline

$$\frac{f_R}{f_{0,n}} \leq 0.95 \quad \text{or} \quad \frac{f_R}{f_{0,n}} \geq 1.05 \quad (6.6.1)$$

$$\frac{f_{R,m}}{f_{0,n}} \leq 0.95 \quad \text{or} \quad \frac{f_{R,m}}{f_{0,n}} \geq 1.05 \quad (6.6.2)$$

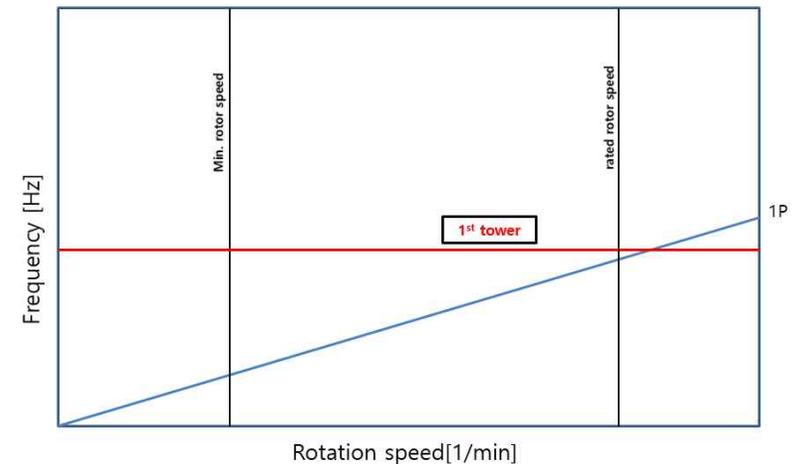
where:

f_R maximum rotating frequency of the rotor in the normal operating range

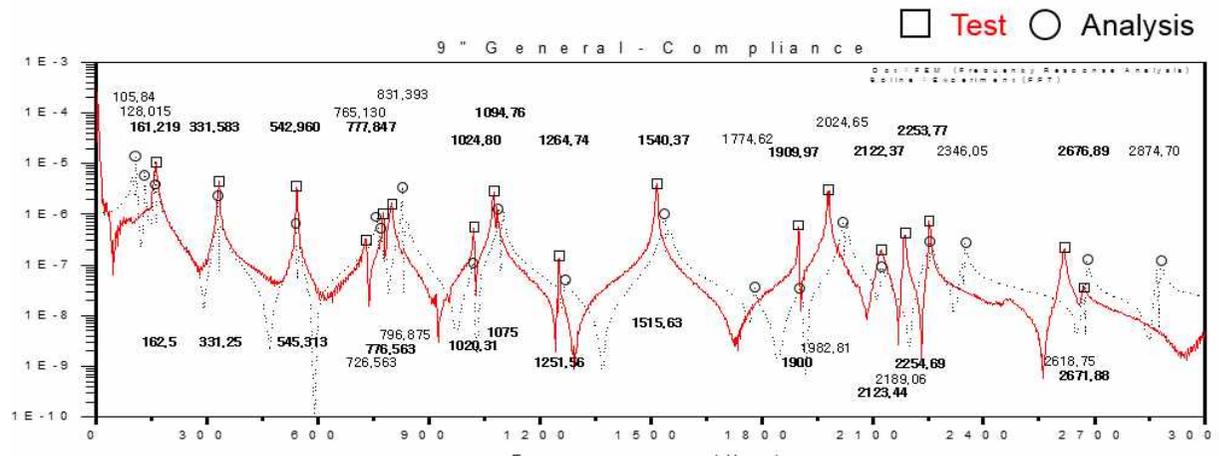
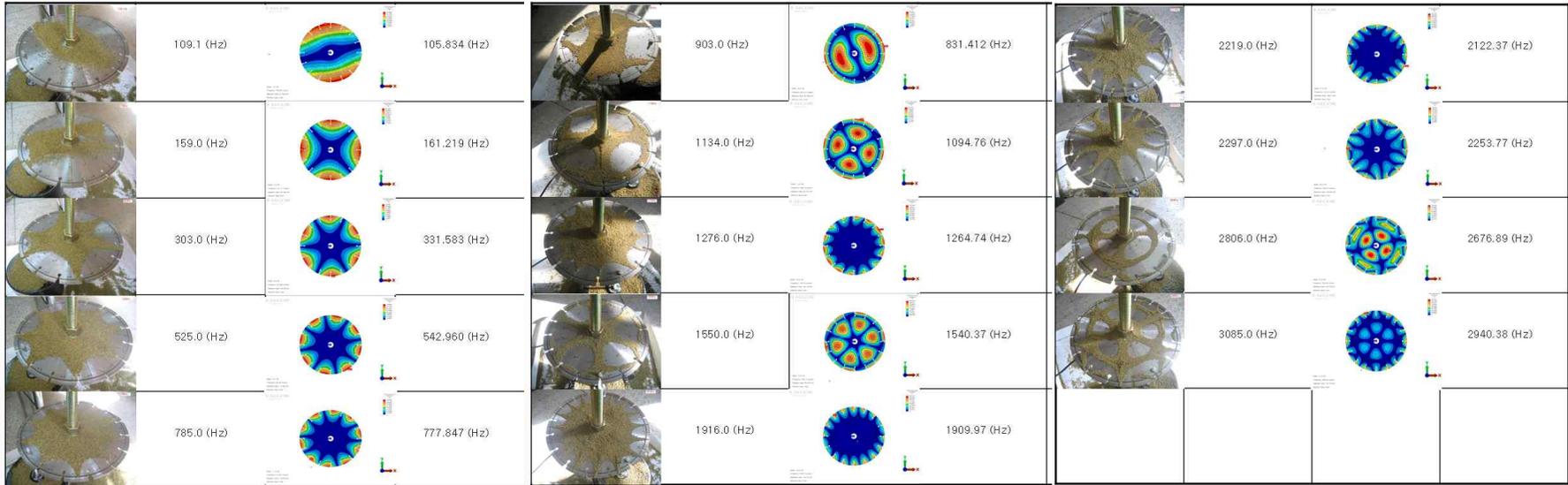
$f_{R,m}$ transition frequency of the m rotor blades

$f_{0,n}$ n-th natural frequency of the tower

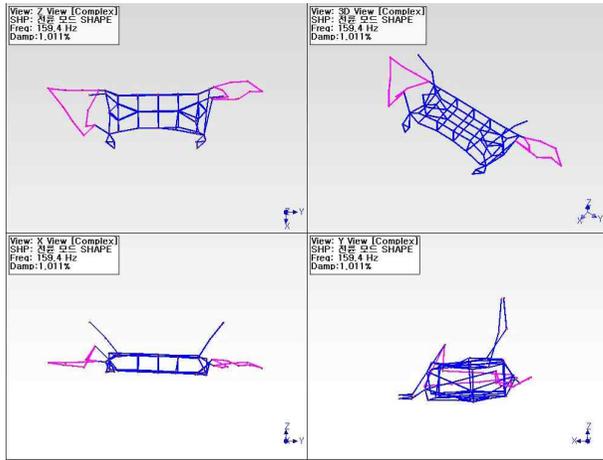
Campbell diagram



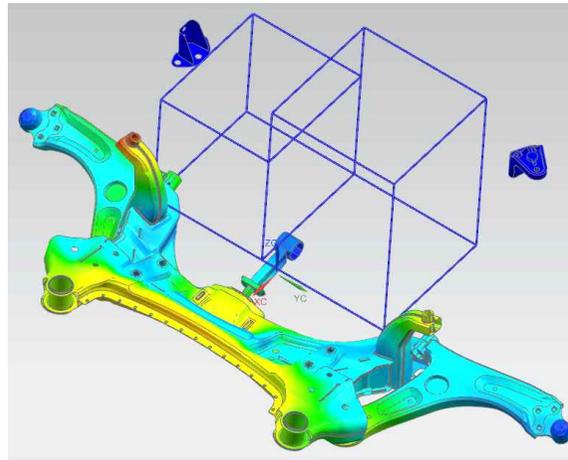
- Sand 법으로 구한 모드 형상과 FRF 측정으로부터의 고유진동수를 유한요소해석 결과와 비교하여 모델을 수정하였으며, 이를 이용하여 최적설계를 위한 모델을 만들었다.



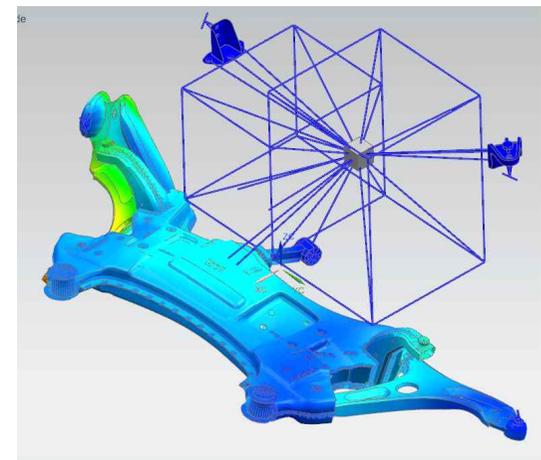
- 차량 Front Suspension의 진동 특성을 파악하기 위하여 진동해석을 수행함.
- 시험 결과와 해석 결과를 비교 검토함.



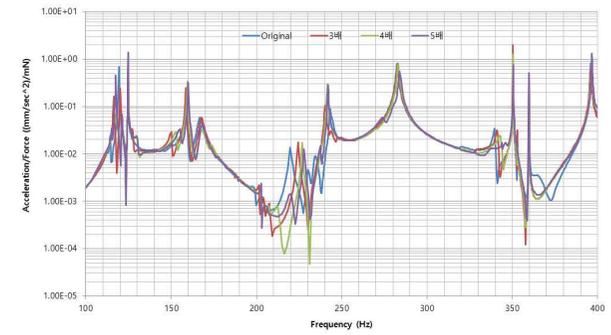
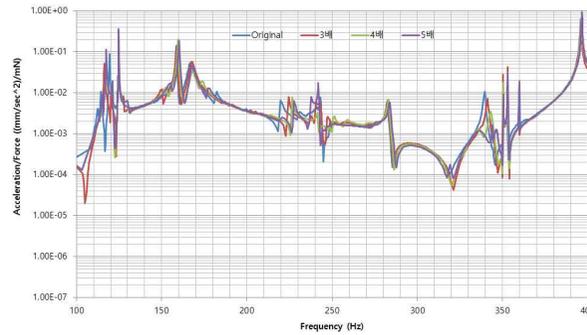
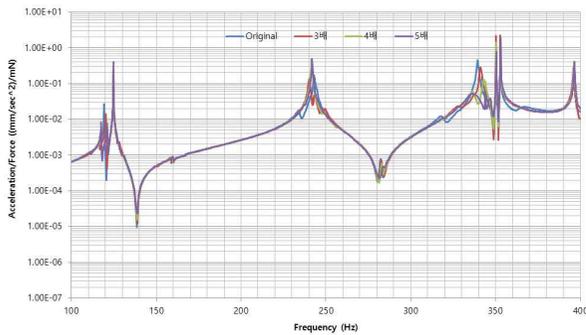
시험 결과



해석 결과



해석 결과 - 보강 후



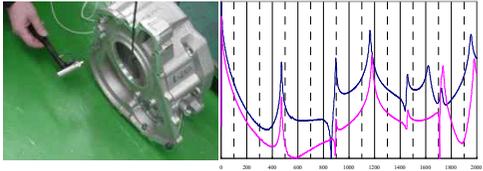
FRF 결과

Case해석 기법 개발

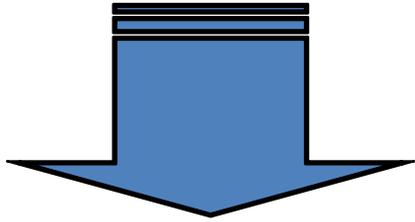
구조 해석
NVH 해석

Pro/MECHANICA

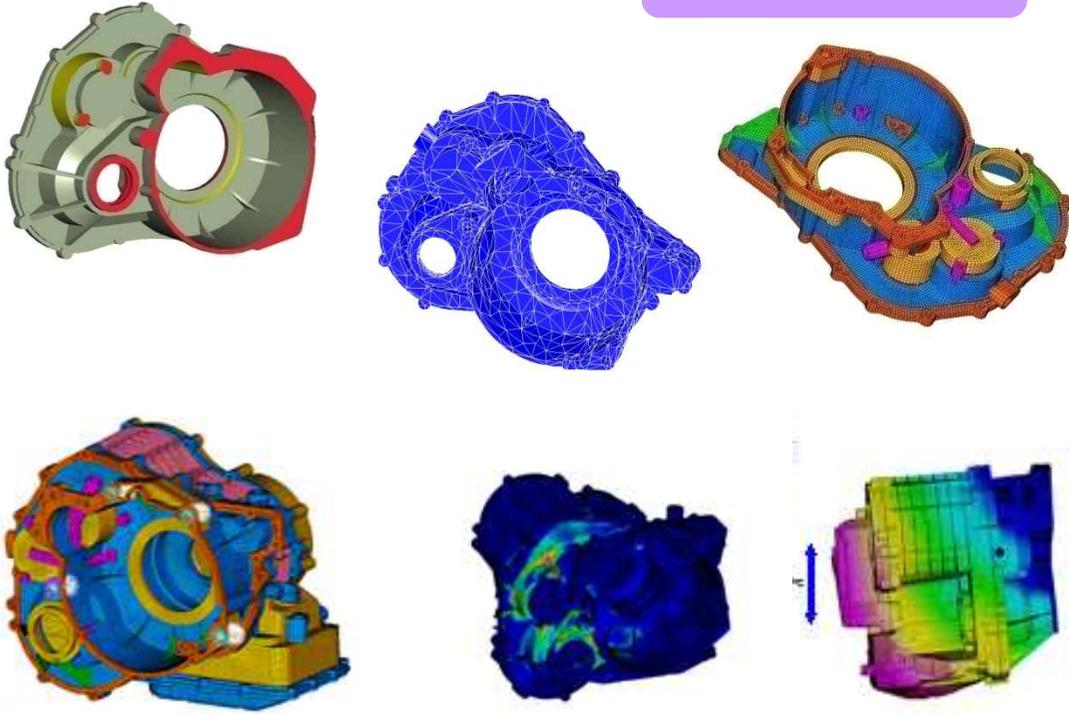
MSC/NASTRAN



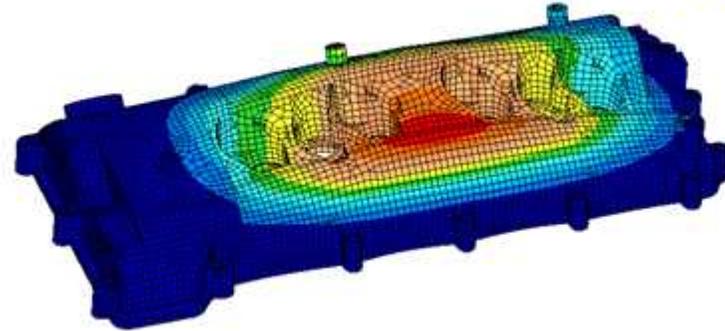
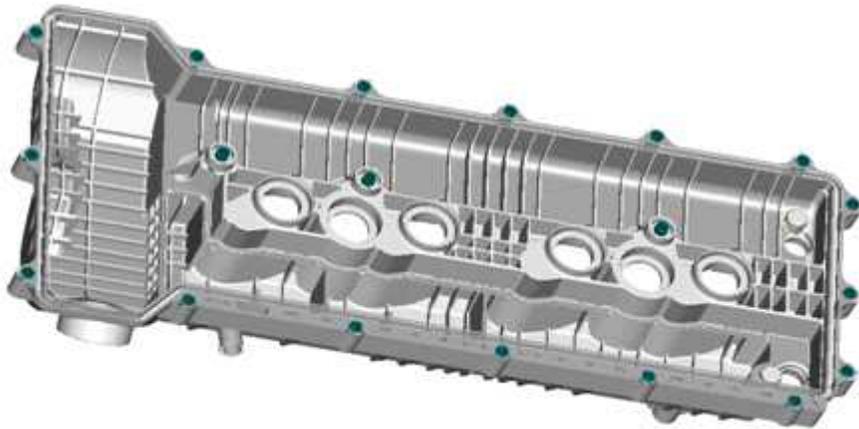
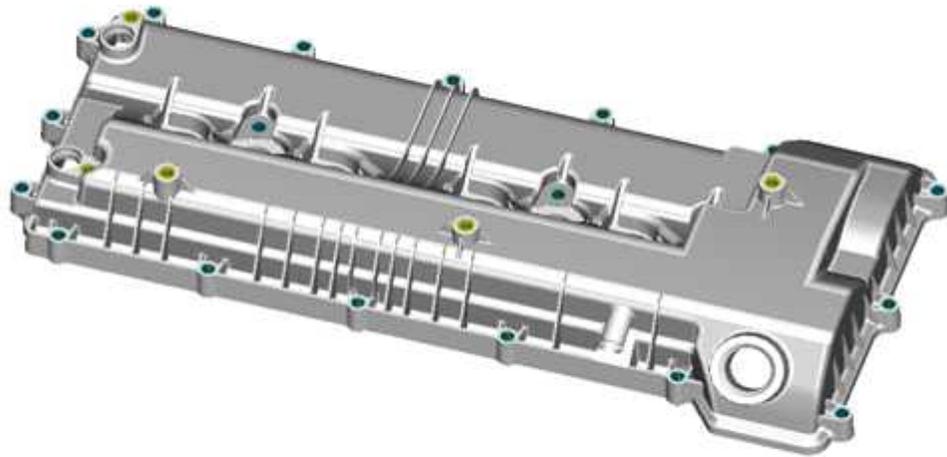
시험결과와 비교, 검증



설계 초기단계에서부터 적용 가능한
양산성 있는 최적 설계 방안 확립



- Cylinder Head Cover 설계 시 진동 특성을 확인하고, 평가기준을 만족하는 설계 변경안을 수립함.

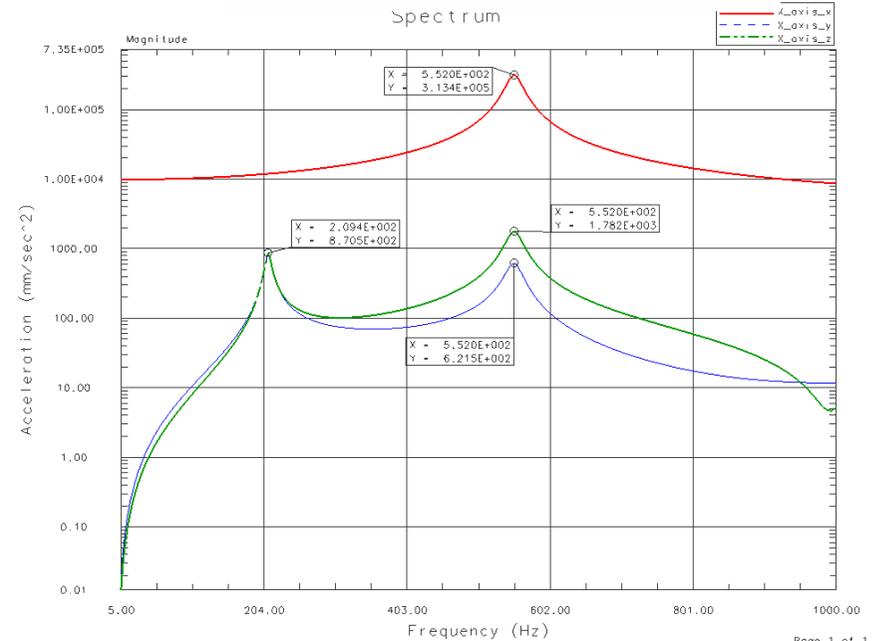
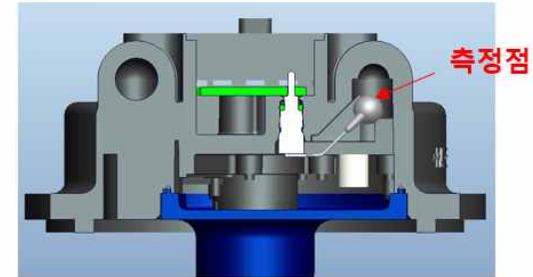
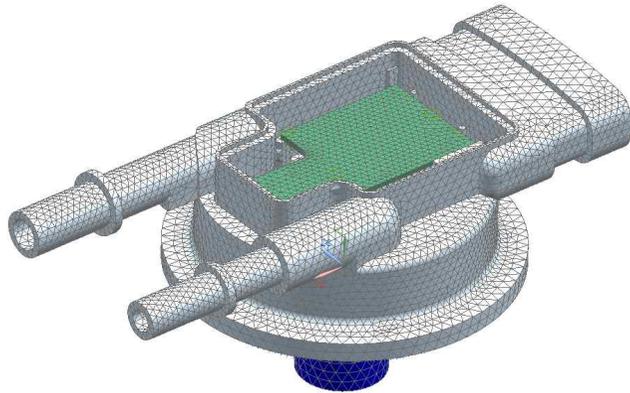
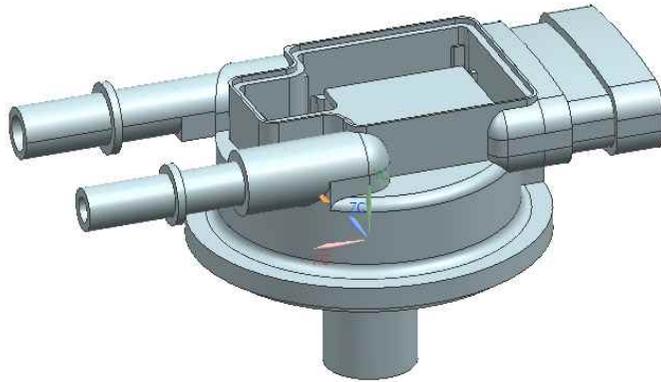


Mode: 1 of 5
Frequency: 430.633 cycles/s
Maximum Value: 58.4614 mm
Minimum Value: 0 mm

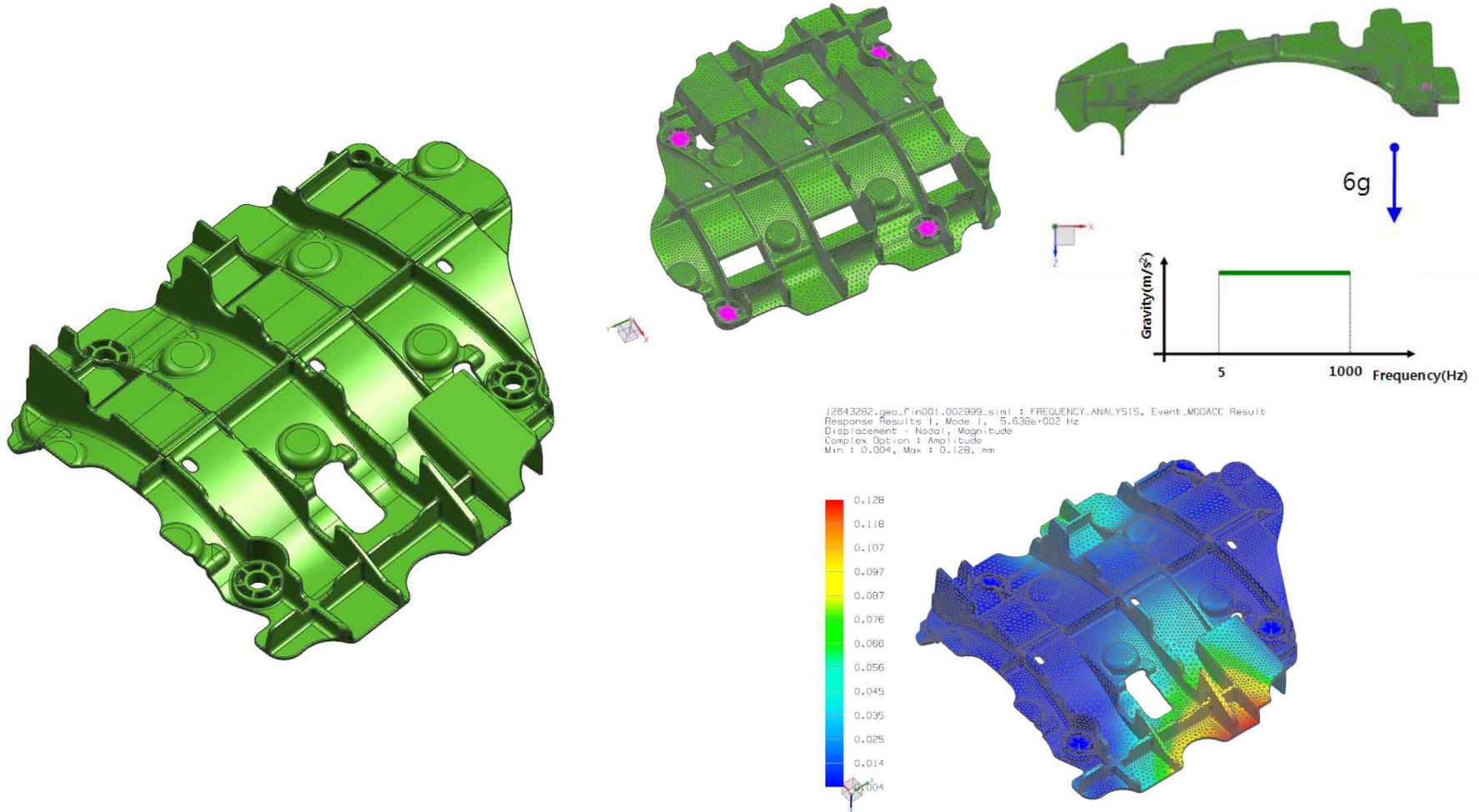


• Group sensor 에 대한 진동 특성을 파악하기 위해 다음과 같은 해석을 수행하였다.

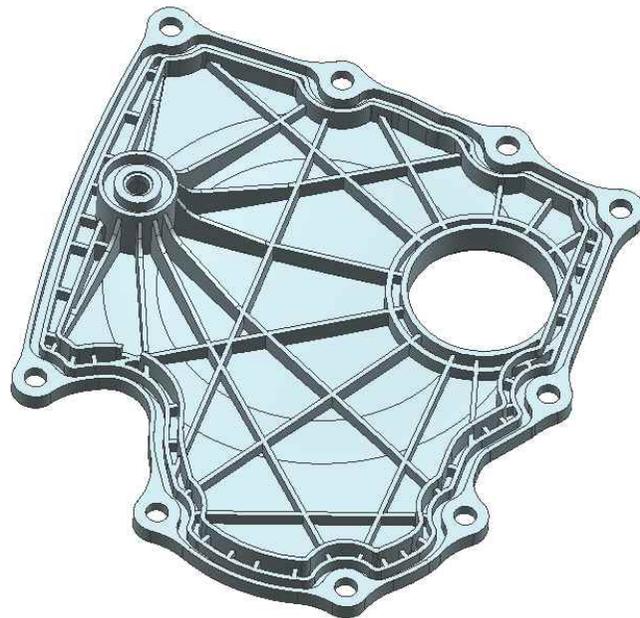
1. Group sensor 의 고유진동수 해석
2. 1G 가속도로 가진 할 때 X,Y, Z 방향 강제 진동 해석



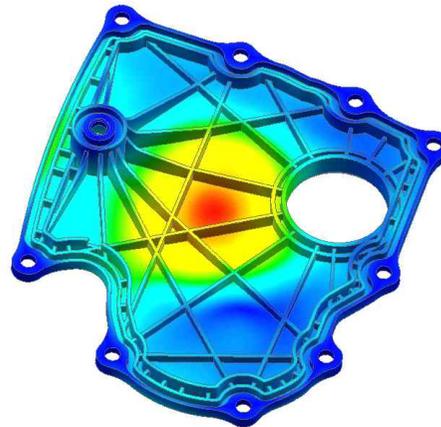
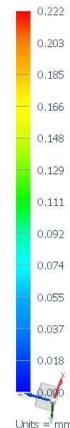
- Deflector에 대한 고유진동수 해석과 주파수 응답 해석 및 공진 여부를 확인, 가진에 대하여 구조물의 안전성을 평가



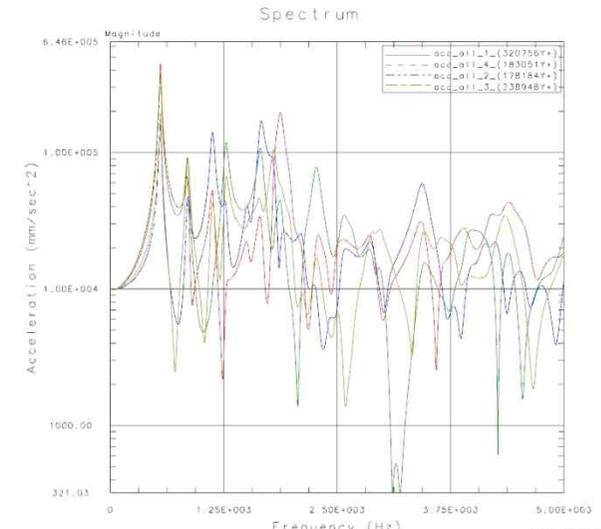
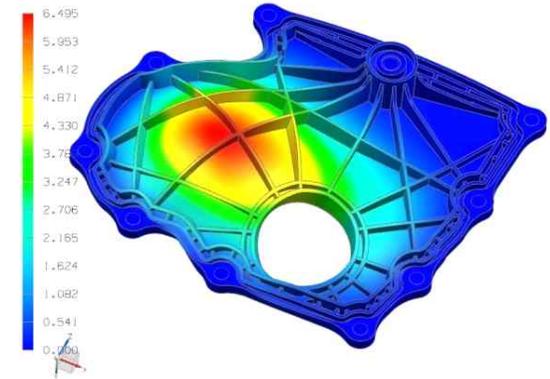
- 본 해석은 PA66+GF35% 재질로 만들어진 Front cover의 구조안전성을 검토하기함.
- Front Cover에 작용하는 온도인 150°C와 -40°C의 온도 조건과 가스켓의 반발력 5N을 적용한 구조해석,
- 모달 해석 및 강제 진동 해석을 수행한다.



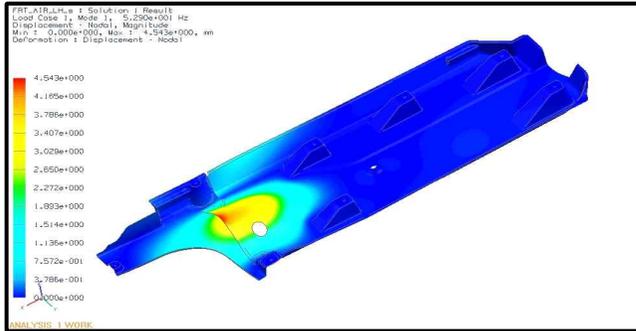
fem1_sim1 : Solution 1 Result
Subcase - Static Loads 1, Static Step 1
Displacement - Nodal, Magnitude
Min : 0.000, Max : 0.222, Units = mm



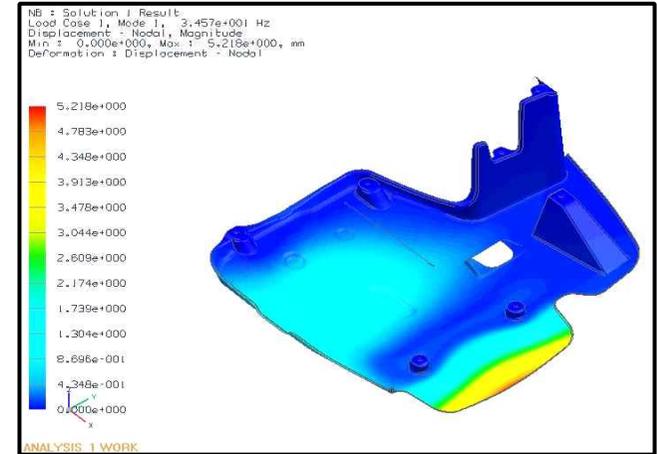
modal_01 : Solution 1 Result
Load Case 3, Mode 1, 5.515e+002 Hz
Displacement - Nodal, Magnitude
Min : 0.000, Max : 6.495, mm
Deformation : Displacement = Nodal, Magnitude



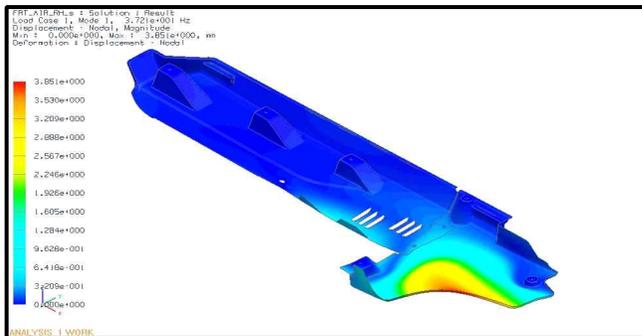
- T300 Under Body & Engine Under Cover에 대한 구조 해석 및 진동해석을 수행하였음.
- 재질 : V-LFT



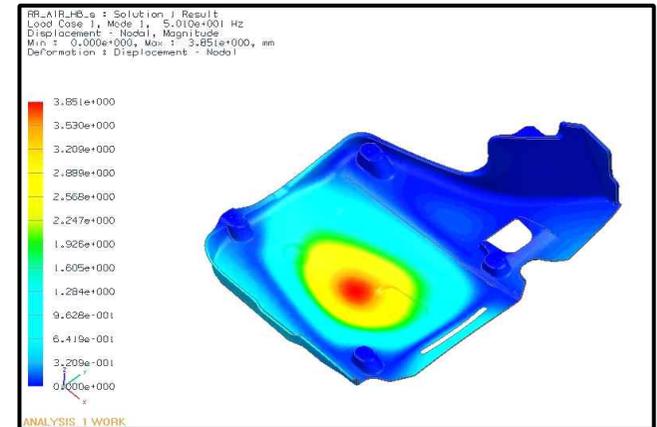
DEFLECTOR ASM-U/B FRT AIR LH



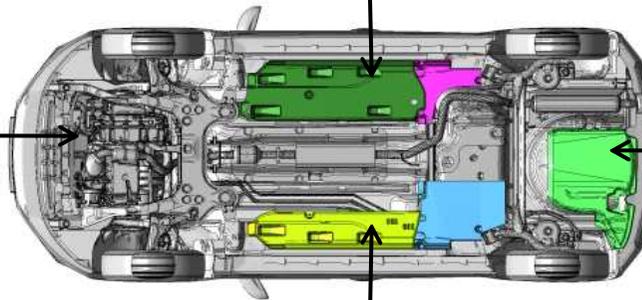
RR DEFLECTOR U/B RR AIR HB
RR DEFLECTOR U/B RR AIR NB

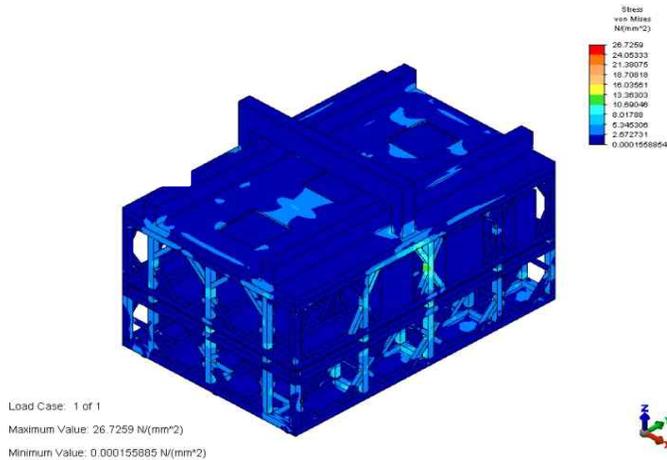


DEFLECTOR ASM-U/B FRT AIR RH

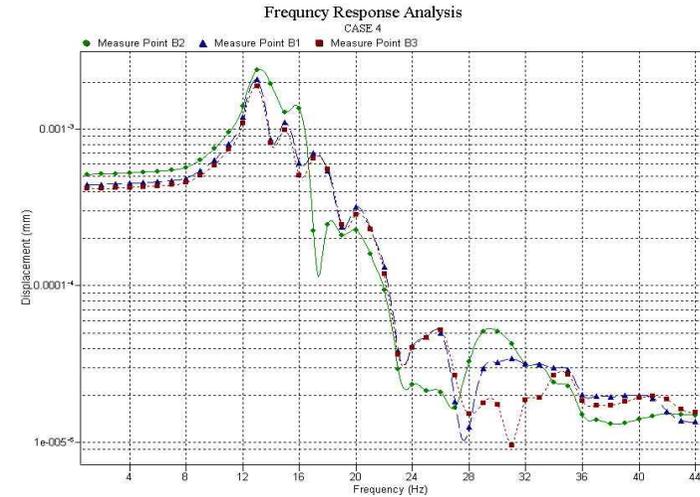


Engine Under Cover

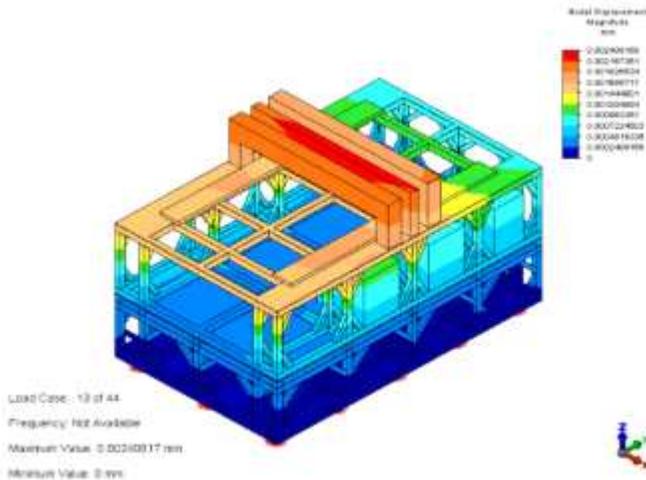




Static Result



Frequency Response Result



Natural Frequency Result

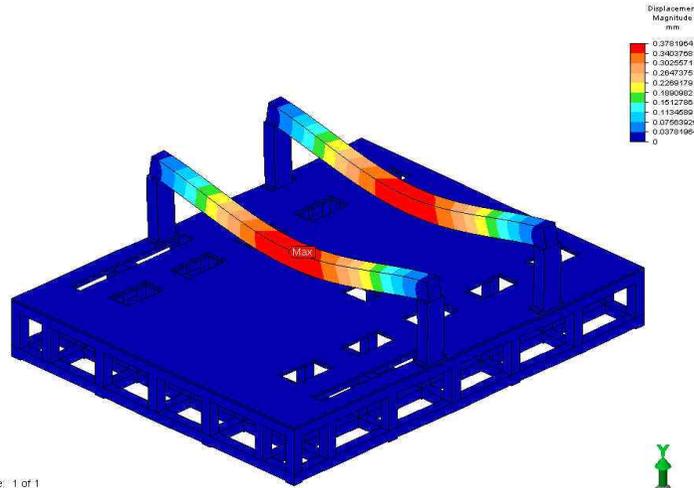
Case	0 ~ 8 Hz		8 ~ 80 Hz	
	Acceleration ($\mu\text{m/s}^2$) - rms		Velocity ($\mu\text{m/s}$) - rms	
	해석모델	Class B 규제치	해석모델	Class B 규제치
1	0.00173	0.13	2.8	25
2	0.00181		2.48	
3	0.00162		1.25	
4	0.00117		0.103	

■ 1g = 1000 gal

초기 모델의 해석

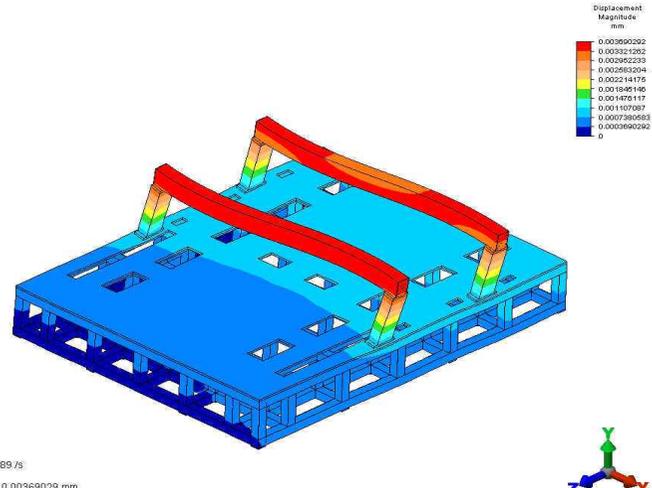


상세변경 모델의 해석



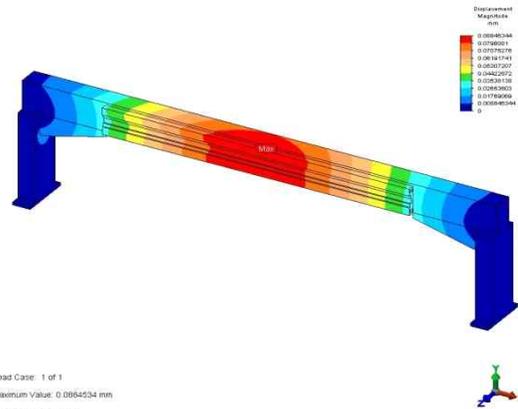
Load Case: 1 of 1
Maximum Value: 0.378196 mm
Minimum Value: 0 mm

Static stress Result



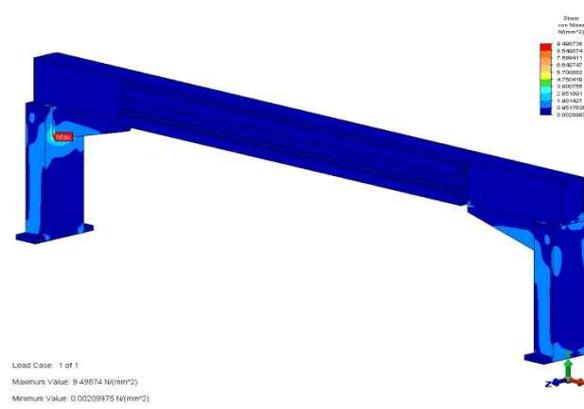
Mode: 3 of 10
Frequency: 50.189 /s
Maximum Value: 0.00369029 mm
Minimum Value: 0 mm

Natural Frequency Result



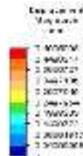
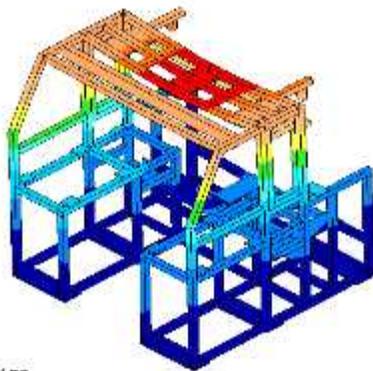
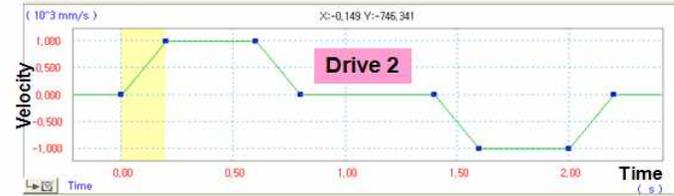
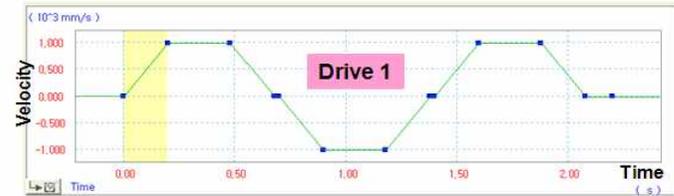
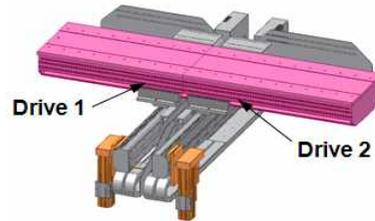
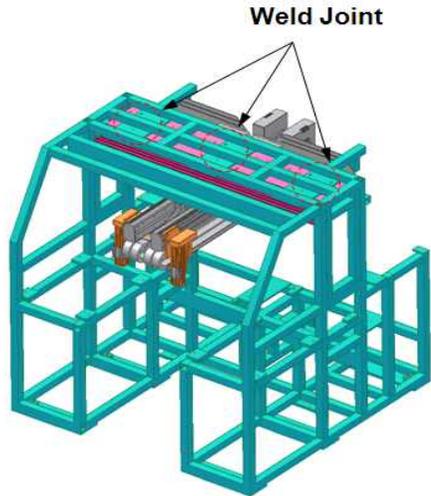
Load Case: 1 of 1
Maximum Value: 0.0864534 mm
Minimum Value: 0 mm

Static stress Result

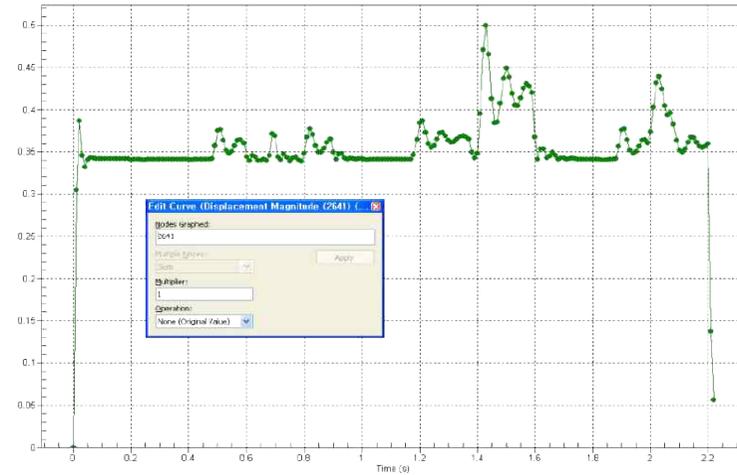


Load Case: 1 of 1
Maximum Value: 9.49874 N/mm²
Minimum Value: 0.0029975 N/mm²

Static displacement Result



Time: 1.45 s
 Time Step: 140.000 s
 Maximum Value: 1492653.1 mm
 Minimum Value: 0 mm

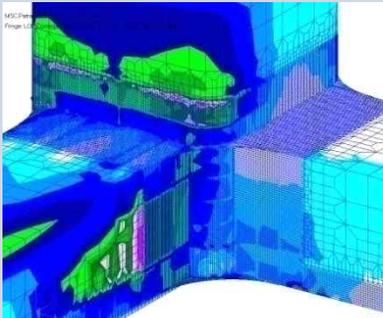
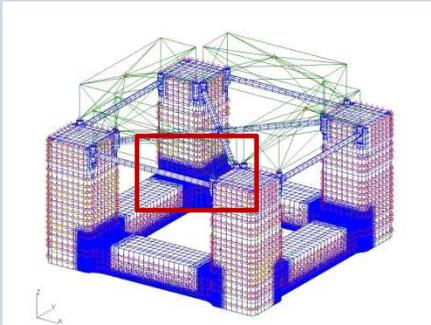


- 180K Bulk Carrier 전선 진동 해석 및 계측, 대한조선(주)
- 207K Bulk Carrier 전선 진동 해석 및 계측, 대한조선(주)
- Cavitation Tunnel 구조 해석 및 진동 해석, 한국해양연구원
- Installation Frame 구조, 진동 해석, 대명엔지니어링
- HIMSEN H25/33 Engine Base Frame 구조진동해석, 현대중공업(주) 선박해양연구소
- 설계자를 위한 해석 교육 및 컨설팅(2001년~2010년, 10년), 현대자동차(주) 남양연구소.
 - 변속기, 엔진 부품 및 Assembly에 대한 기구동역학/구조/진동/열전달/피로/최적화 해석.
 - 해석을 고려한 3차원 모델링 기법.
- 디젤 P/T NVH 모델링 및 진동 해석 기술용역, 현대자동차(주) 남양연구소.
- 무단변속기(CVT) 개발 프로세스 정립, 현대자동차(주) 파워트레인 연구소.
- 저소음 저진동 Cutter 개발을 위한 선행 연구, 신한다이아몬드(주)
- 20kW 풍력 발전기 진동 해석

- PDP 검사기 & 복합기 구조/진동 해석, DIT
- 초정밀 반도체 측정장비 구조/진동 해석, 삼성SDI
- T300 Under Body & Engine Under Cover 구조/진동 해석, (주)J.I Korea, 한국GM
- Front Cover 구조 및 진동 해석, (주)데스코
- Deflector 진동 해석, (주)데스코
- Groupsensor 진동 해석, (주)데스코
- Cylinder Head Cover 진동해석 및 설계 변경, LG 화학(주)
- 차량 Front Suspension 진동 해석, B&K Korea, 현대자동차(주)

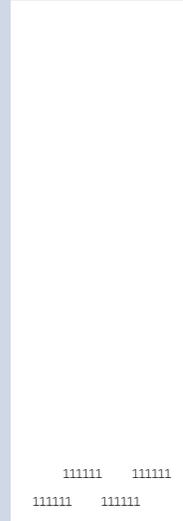
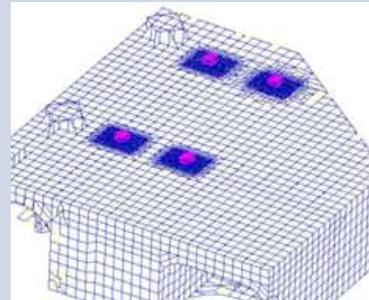
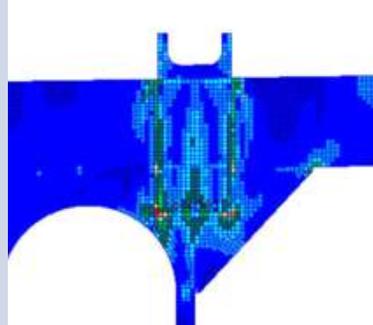
4. 조선/해양/플랜트 분야 보유 기술

운송 해석



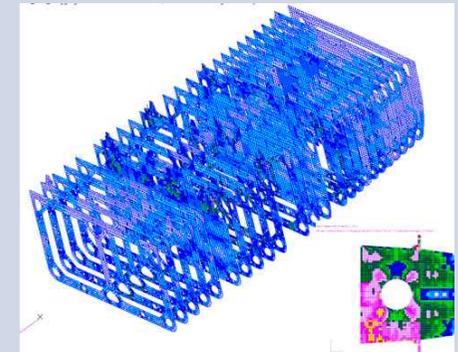
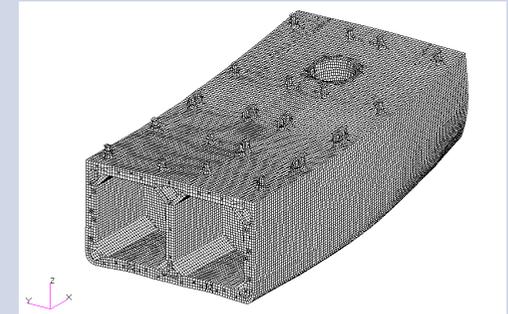
선박 및 Block 운송시 선체의 구조적 안전성 검토

국부 해석



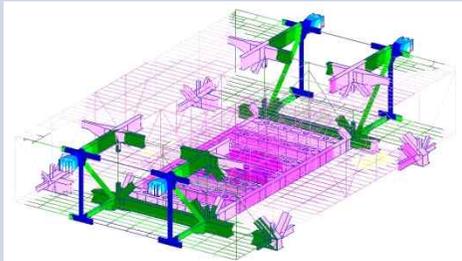
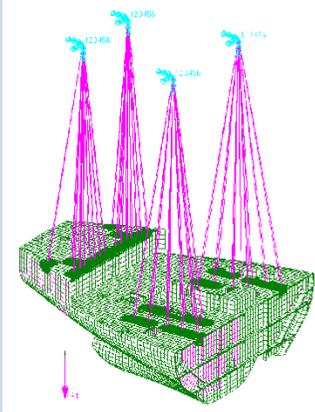
Crane, Flare tower, Telecom master, Lifeboat, Helideck 등의 하부 국부 응력 평가

Cargo Hold 해석



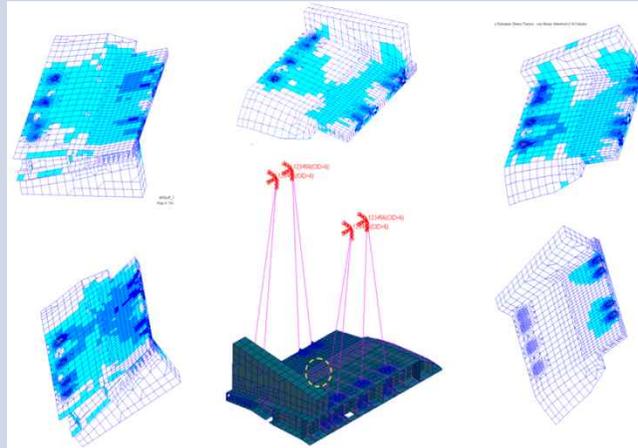
선급Rule에 따른 Cargo Hold 구조 강도 평가

Block lifting 해석



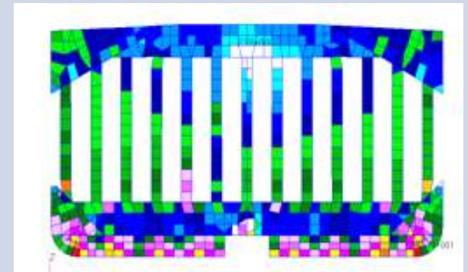
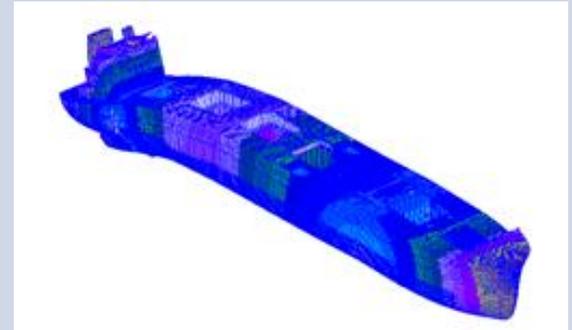
Topside 구조물Lifting시 구조적 안전성 검토

Block Turnover 해석



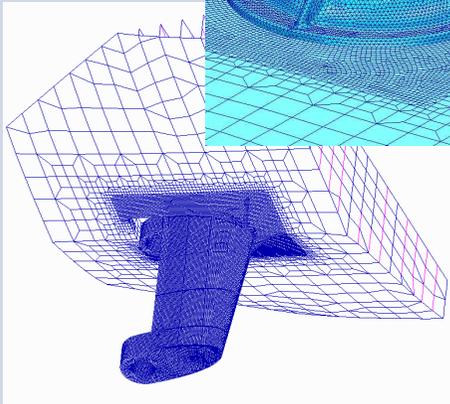
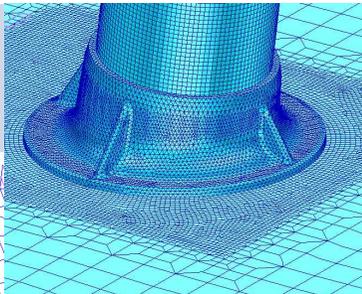
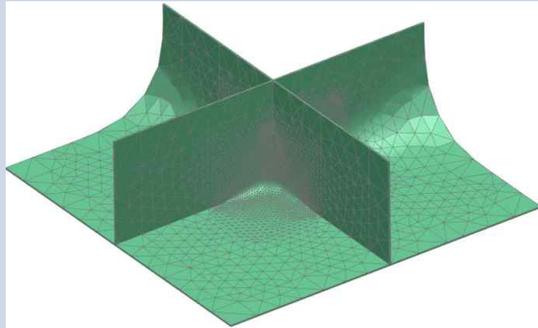
Block의 탑재를 위해 Turnover시 Block의 구조적 안전성 검토

Loadout 해석



육상건조 선박 또는 Block의 진수 시 선체의 구조적 안전성 검토
- 종방향 진수, 횡방향 진수

Solid FE Modeling

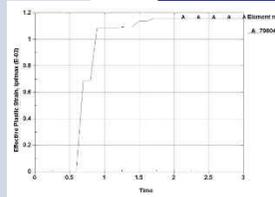
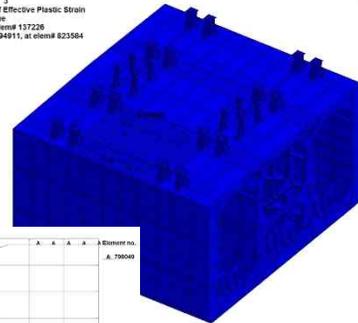


비선형 해석



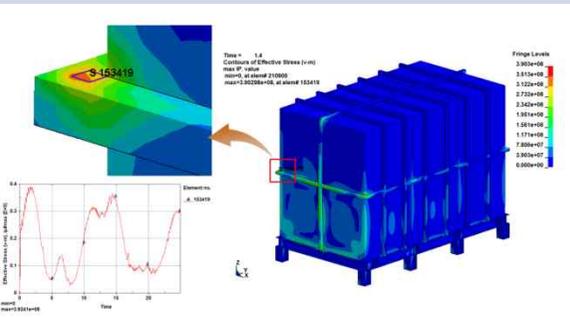
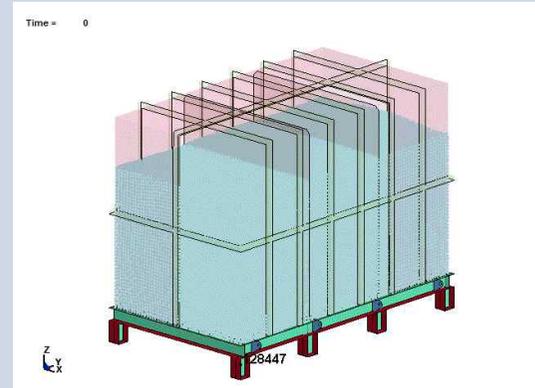
Time = 3
Contours of Effective Plastic Strain
max IP value
min=0, at element 137226
max=0.00294911, at elem 823584

Fringe Levels
2.848e-03
2.654e-03
2.359e-03
2.064e-03
1.769e-03
1.473e-03
1.180e-03
8.847e-04
5.898e-04
2.949e-04
0.000e+00



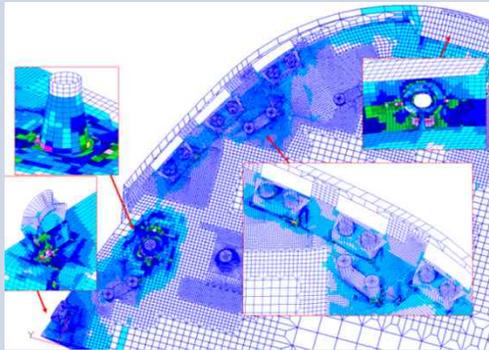
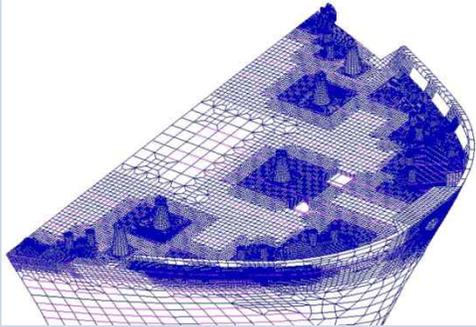
LS-DYNA, NASTRAN
SOL600(MARC)이용한
비선형 해석- Blast Analysis

Slosh Analysis



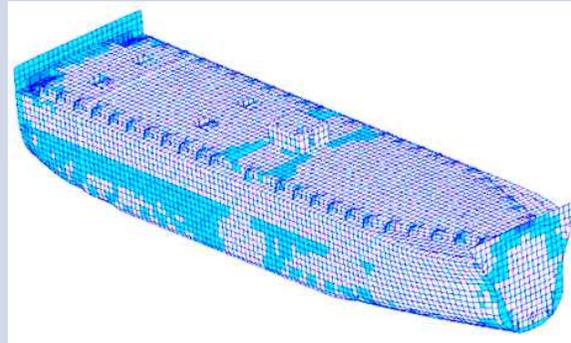
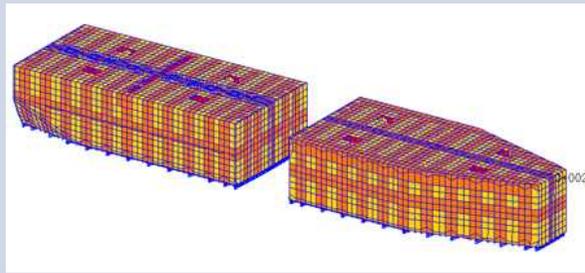
Sloshing을 고려한 구조물의
안전성 검토

Mooring Fitting 하부해석



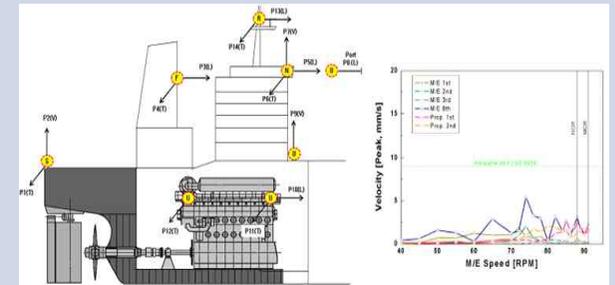
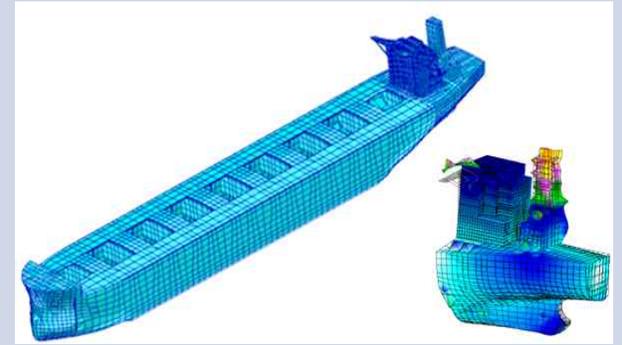
Mooring Fitting 하부의 구조 강도 평가

열전달/열응력 해석



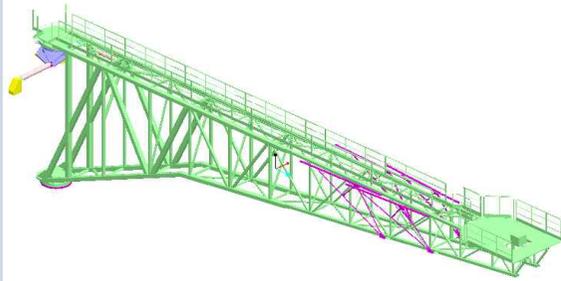
열전달 해석을 통한 열분포 계산 및 선체의 열응력 평가

진동 해석 및 시험



전선 진동해석 및 계측

설계국산화(개발)

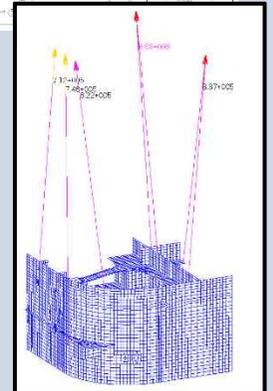
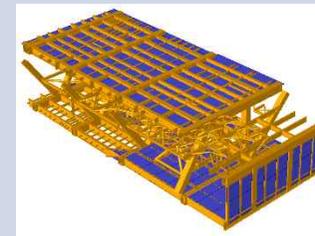
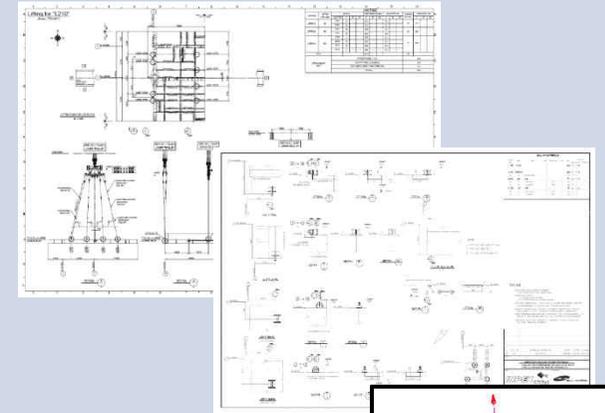


Burner boom 설계국산화
-3D CAD 및 CAE기술을
활용한 설계/해석/도면

Jacket 설계/해석



Block Handling (도면/해석)

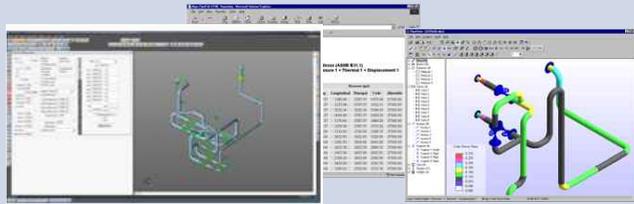
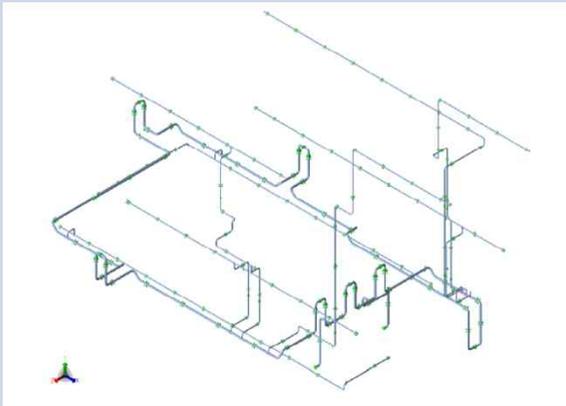


도면(Sling, Lug Detail),
Analysis for Lifting & T/O

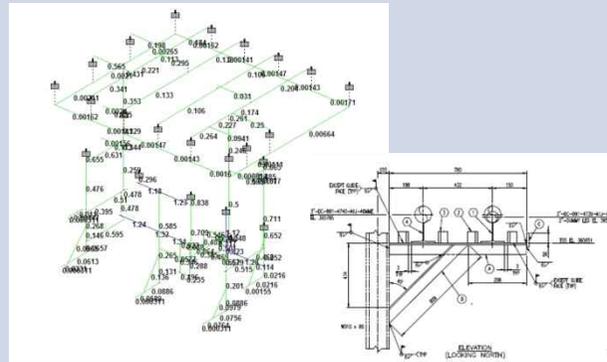
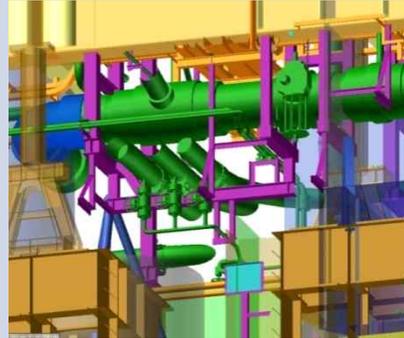
배관응력해석

Pipe Support 해석

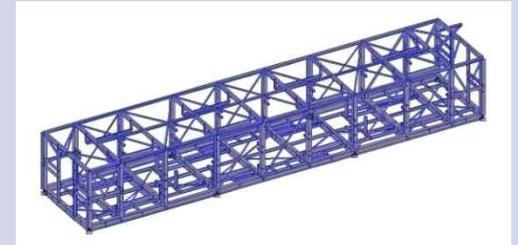
Steel Structure 해석



Pipe Stress Analysis
(ASME B31.1 & B31.3)

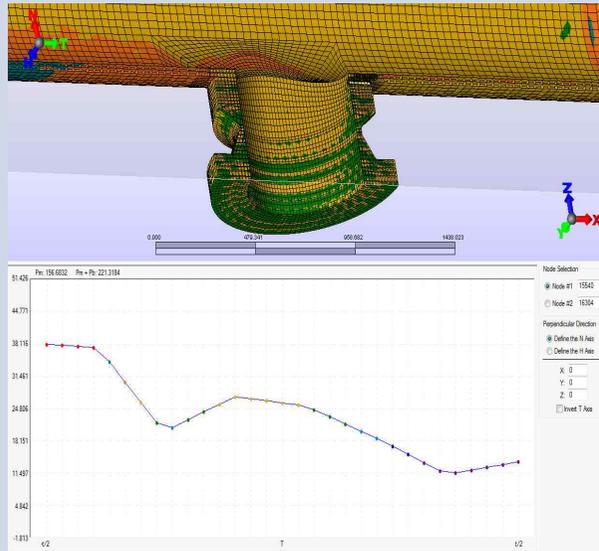


Pipe Support의 구조해석



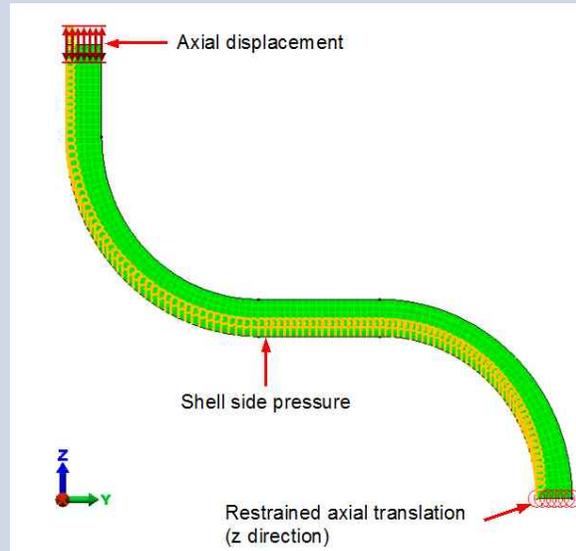
Steel Structure의 구조해석

Nozzle 해석



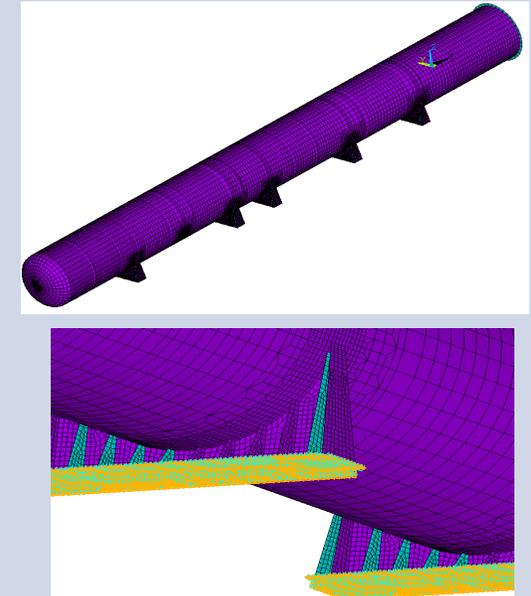
ASME Sec. VIII, Div.1/Div.2에 의거한 Nozzle 해석

Expansion Joint 해석



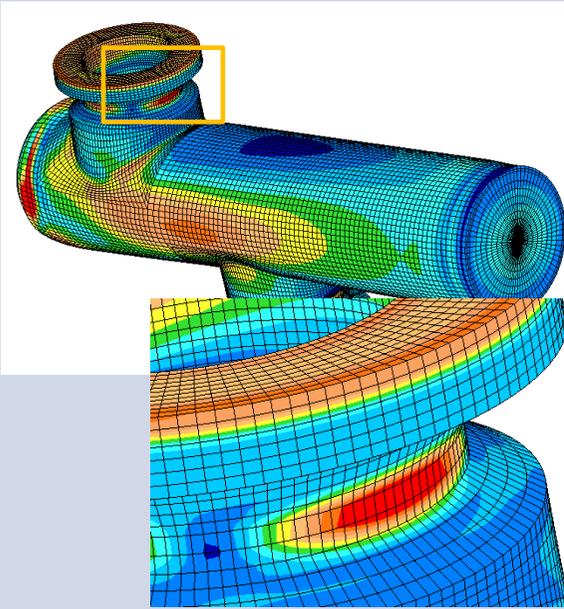
TEMA 9th Edition에 의거한 Expansion Joint FEA 해석

운송 해석



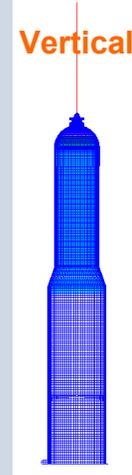
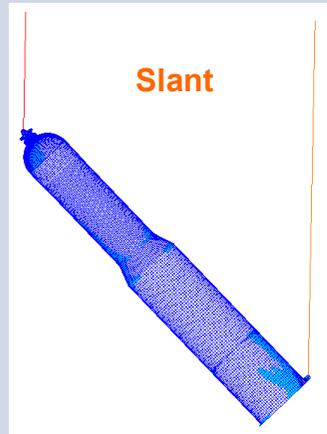
운송조건해석
- Saddle, Support beam, Stool, Pad plate 등의 강도 평가

피로 해석



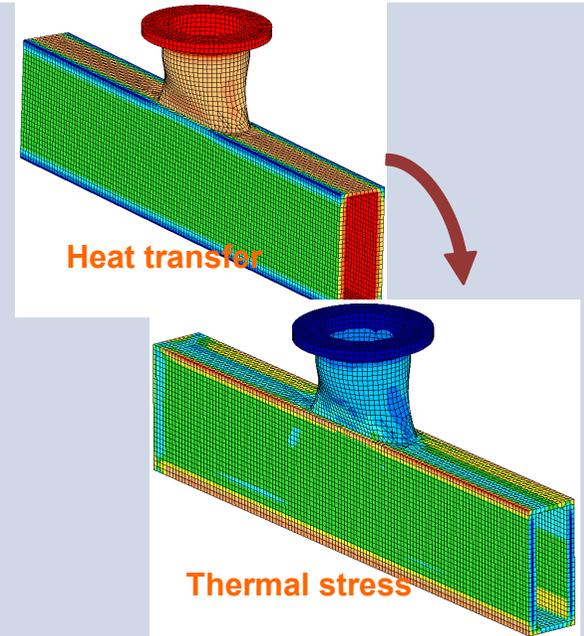
FEA를 통한 접합부 응력
계산/피로 강도 평가

Lifting 해석



운송 및 설치 시 기기의
Lifting 및 Erection조건 해석

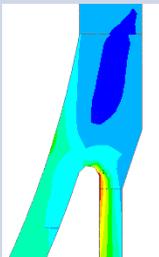
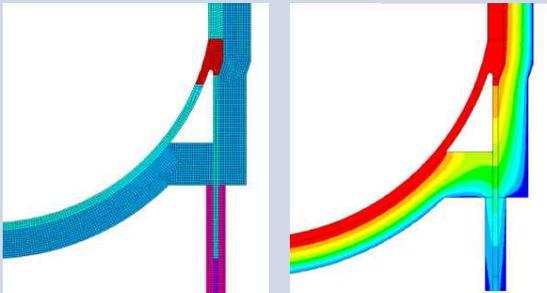
열응력 해석



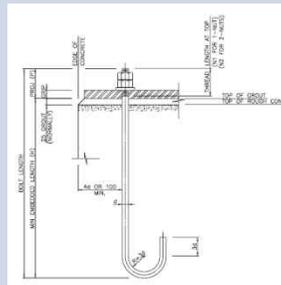
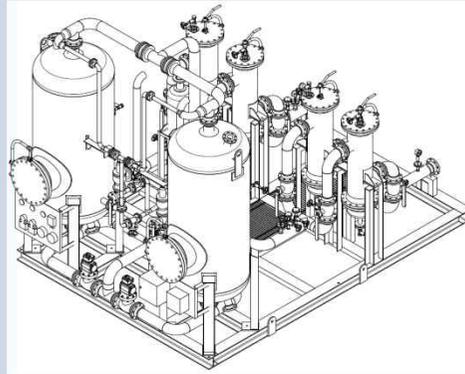
고온의 압력용기의 열전달
해석 후 열분포에 따른
열응력 해석

열전달 및 구조해석

- Hot Box Design(Thermal stress analysis)
- Stress Analysis for Skirt to Head Junction



SKID 구조해석



- Stress Analysis for Skid
- Anchor Bolt Check

감 사 합 니 다.



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E-mail : cae@cae.co.kr