

# LNG

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## Experimental Study of Dynamic Response for Pilot LNG Storage Tank

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**Key Words:** LNG storage tank(LNG ), Dynamic Response( ), Impact load( )

**Abstract :** The demand of LNG in Korea has dramatically increased since it was first imported in 1986. Thus, more LNG storage tanks are required to meet the growing consumption of LNG. However the design, construction, and analysis of LNG storage facility need highly advanced technology compared to the general structures due to the fluid-structure interaction and the low temperature of LNG. Recently Korea Gas Corporation(KOGAS) constructed a pilot LNG storage tank, and it is in operation to develop and accumulate the core technology. As a part of those objects, the fundamental dynamic test for the pilot tank were performed. For this study, dynamic test were carried out and the dynamic characteristics of the pilot tank were verified and analyzed.

1. pilot

1986 2

(Liquefied Natural Gas) LNG 가

LNG 가  
-162  
LNG가  
가

2.

LNG 가

2.1 Pilot LNG

LNG 가  
LNG

2001 12 pilot LNG

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\* 가

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37 pedestal  
pedestal  
(isolation pad)가

6.88m  
7.09m  
21cm  
60cm,  
70cm  
Fig1 Fig2



Fig1. Overview of Pilot LNG Tank

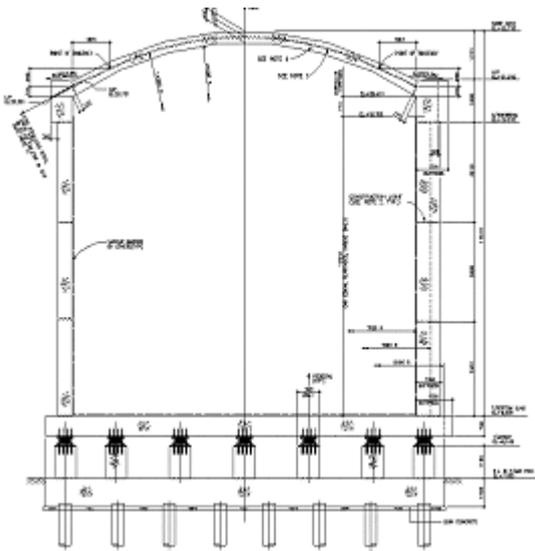


Fig2. Specification of Pilot LNG Tank

2.2

Fig3  
가 가  
A/D  
(Fast Fourier Transform : FFT)  
가 가

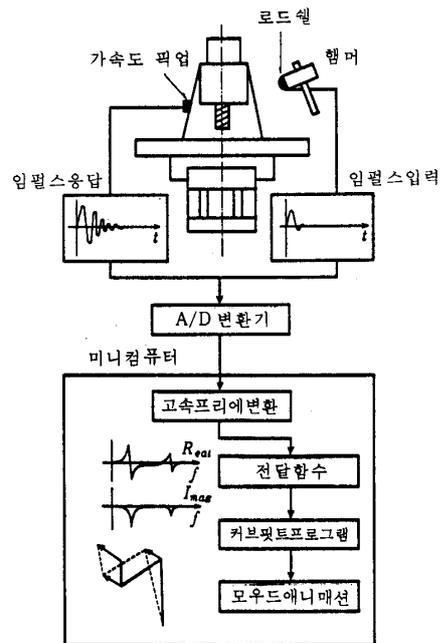


Fig3. Test Procedure for Mode Analysis

2.3

가 가 , 가  
가 FFT analyzer가  
( 4 ) PCB  
Model 086D50 Sledge Impulse Hammer  
가  
5000Lb( 2.3 ) lbf 1mV

Table1 PCB Impulse Hammer



Fig4. PCB Impulse Hammer

Table 1 Specification of Impulse Hammer

Sensitivity	0.94mV / lbf
Force Range	0 - 5000 lbf
Head Mass	12.1 lbf (5.5kg)
Freq. Range	Hard Tip - 750 Hz Medium Tip - 650 Hz Soft Tip - 350 Hz Super Soft Tip - 250 Hz

가 PCB Model 393A03  
 Seismic Accelerometer 5g g  
 1000mV 가  
 0.5Hz 2000Hz ( 5%) Fig5  
 가



Fig.5 Accelerometer attached on the tank

가  
 FFT Analyzer FFT  
 ONIC Medallion 16

Fig.6 10KHz Medallion FFT analyzer



Fig6 Medallion FFT Analyzer

2.4  
 Figure7

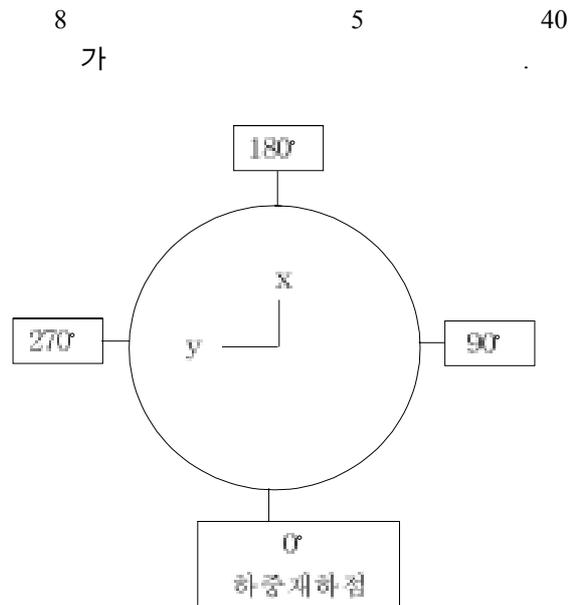


Fig7. Location of Impact loading

0.75H 가  
 200Hz 가  
 가 Impulse Hammer  
 가 A/D  
 FFT

가 가

3.

3.1

LNG

Fig7 Sledge Hammer  
가

Fig8 FFT(Fast Fourier

Transform)

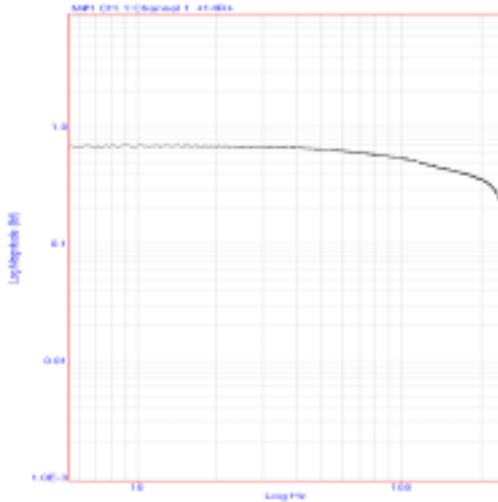


Fig.7 Wave by Impact Hammer

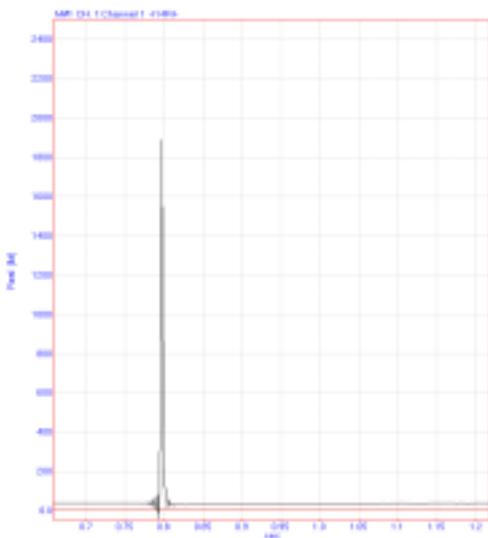


Fig.8 Wave Spectrum of Impulse

Fig8에서 볼 수 있듯이 대략100Hz까지의 주파수

대역에서 일직선모습을 보여주며 이는 저장탱크의 고유모드 중 100Hz이내의 모드는 해머에 의한 충격으로 충분히 가진할 수 있다는 것을 보여준다. Fig.9은 세로1열의 주파수 응답함수를 보여주고 있다.

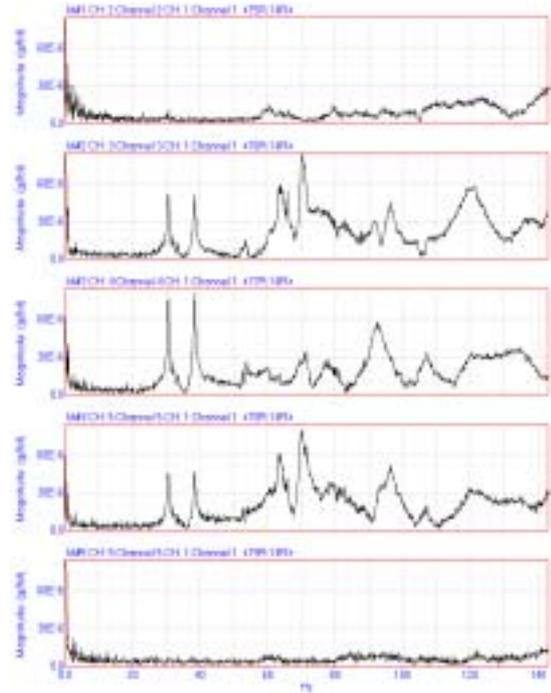


Fig.9 Frequency Response Function

3.2

Fig10 Fig13  
31.5Hz ,38.25Hz ,52.75Hz

,69.5Hz

31.5Hz , 가

가

pilot

38.25Hz

1

52.75Hz

가  
 pilot 가  
 가 69.5Hz  
 , 2  
 가 ,

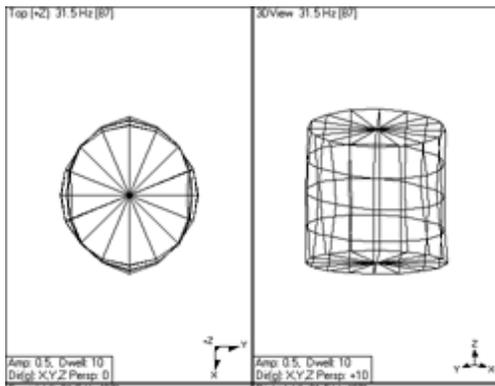


Fig10 Mode Shape at 31.5 Hz

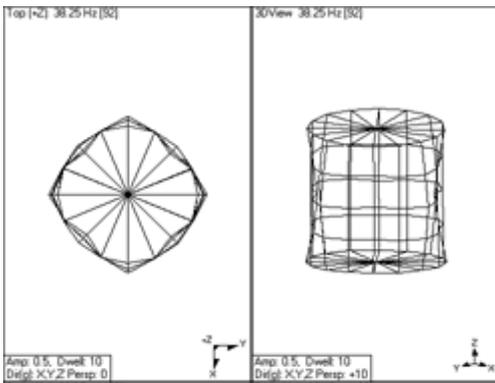


Fig11 Mode Shape at 38.25 Hz

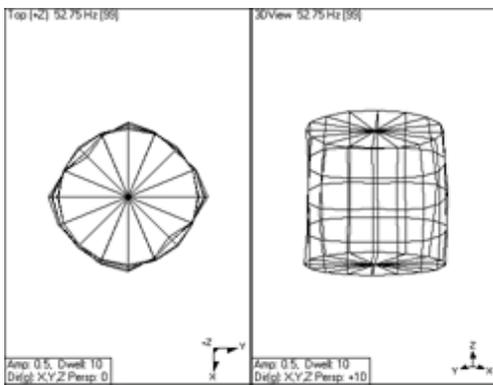
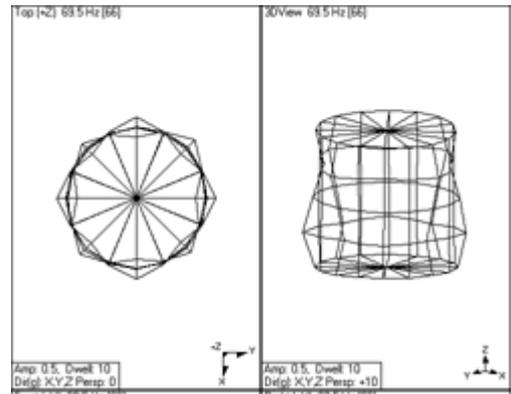


Fig12 Mode Shape at 52.75 Hz

Fig13 Mode Shape at 69.5 Hz



3.3

SAP2000

Impulse Hammer 가

Isolator

가

Fig14

33.89

31.5Hz

Fig15

37.03Hz

38.25Hz

3.4.28,

3.4.29

65.79Hz

69.5Hz

5

Table 2 Comparison of Frequency(Hz)

Case	(Hz)	(Hz)	(%)
1	31.5	33.89	8
2	38.25	37.03	-3
3	52.75		
4	69.5	65.79	-5
5	80.5		

Case1, Case1, Case4

10%

, Case3, Case5

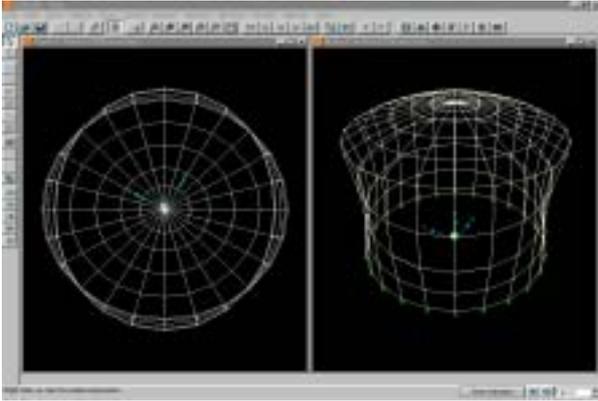


Fig14 Mode shape at 33.89Hz(Analysis)

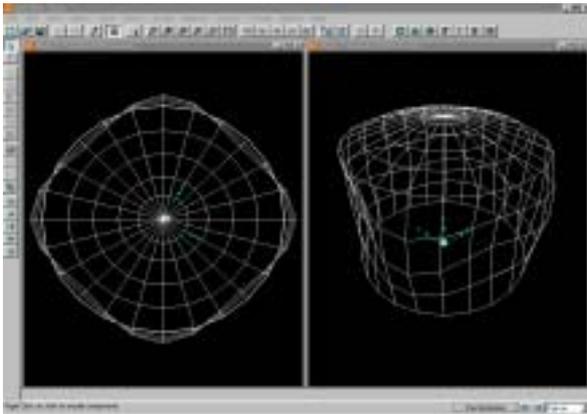


Fig15 Mode shape at 37.03Hz(Analysis)

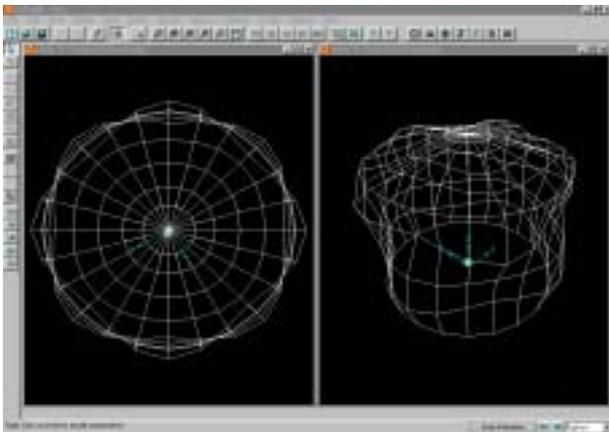


Fig16 Mode Shape at 65.79Hz(Analysis)

4.

LNG

LNG

$$x = \frac{8}{5} = 40 \quad ( \quad 8 \quad \text{가} )$$

가

가

Impulse

Hammer LNG Tank

FFT(Fast

Fourier Transform)

100Hz

Tank

100Hz

Hammer

가

FFT

1 가

(Frequency Response Function)

, 31.5Hz, 38.25Hz, 52.75Hz, 69.5Hz, 80.5Hz

31.5Hz, 38.25Hz, 69.5Hz

SAP2000

10%

52.75Hz 80.5Hz

pilot

가

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