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Artikel: LNG inground storage tanks (Japan)
Autor: The Tokyo Electric Power Co., Inc.
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4. LNG Inground Storage Tanks (Japan)

Owner: *The Tokyo Electric Power Co., Inc.*

Engineers: *The Tokyo Electric Power Co., Inc./Tokyo Electric Power Services Co., Ltd.*

Contractor: *Kajima Corporation/ Simizu Construction Co., Ltd. (Civil Work)*

Site: *Futtsu Thermal Power Station, The Tokyo Electric Power Co., Inc., Chiba-ken, Japan*

Dimensions:

diameter:	*70 m*
depth:	*38 m*
side wall thickness:	*2.3 m*
bottom slab thickness:	*5.5 m*

Quantities of materials (per one tank for civil work):
37,000 m³ concrete
6,000 t reinforcing bar

Work's duration: *43 months (including appurtenant work)*

Service date: *1985*

Introduction

LNG (liquefied natural gas) is the colorless liquid which temperature is -162°C. LNG is very clean energy, that is, it doesn't include any impurities.

The inground storage tank consists of inground cylindrical body, aboveground dome-shaped roof, and inner membrane container.

The reinforced concrete bodies – i.e. a cylindrical side wall and circular bottom slab – withstand several loads, such as earth pressure containing liquid pressure, etc. The stainless steel membrane works as a liquid container. There is a heat insulation layer between the concrete body and the membrane. The steel roof is a gas-tight structure supporting a suspended deck.

The greatest advantage of the inground LNG storage tanks is the high degree of safety: there is no possibility of liquid spilling onto the ground surface.

Design

In the design of the concrete body, the following loads are taken into consideration:

dead weight
gas pressure by vaporized LNG
liquid pressure by LNG
earth pressure
ground-water pressure
roof load
thermal load
loads caused by earthquake

Design loads (4) and (8) are not axisymmetrical. The thermal load means the function that generates the thermal stresses.

The thermal stresses are caused by the temperature distribution in the side wall and bottom slab, due to the cryogenic temperature of LNG.

The loads caused by earthquake are the earth pressure increase during earthquake, the inertia forces of concrete body and roof, and the dynamic liquid pressure of LNG.

The seismic coefficient is 0.3 at the ground surface.

Construction

The construction procedure of the inground tank is as follows:

1st step: construction of cut-off and retaining wall (slurry wall)
2nd step: excavation of the inner ground of the slurry wall
3rd step: casting of bottom slab concrete
4th step: casting of side wall concrete
5th step: erection of steel roof
6th step: installation of insulation and membrane

Research and Development

The following research and development has established the inground LNG storage technology:

1. research on the material properties under low temperatures – concrete, reinforcing bars, and reinforced concrete,
2. research on the seismic behavior of inground tank,
3. research on the properties of frozen soil and frost heaving,
4. development of analytic programme - heat conduction analysis, structural analysis, and seismic analysis,
5. development of the construction technology of deep slurry wall for the retaining and water cutoff wall,
6. development of the heater system technology to control the soil freezing,
7. development of the design and construction technology of mass concrete such as very thick bottom slab.

(TEPC)

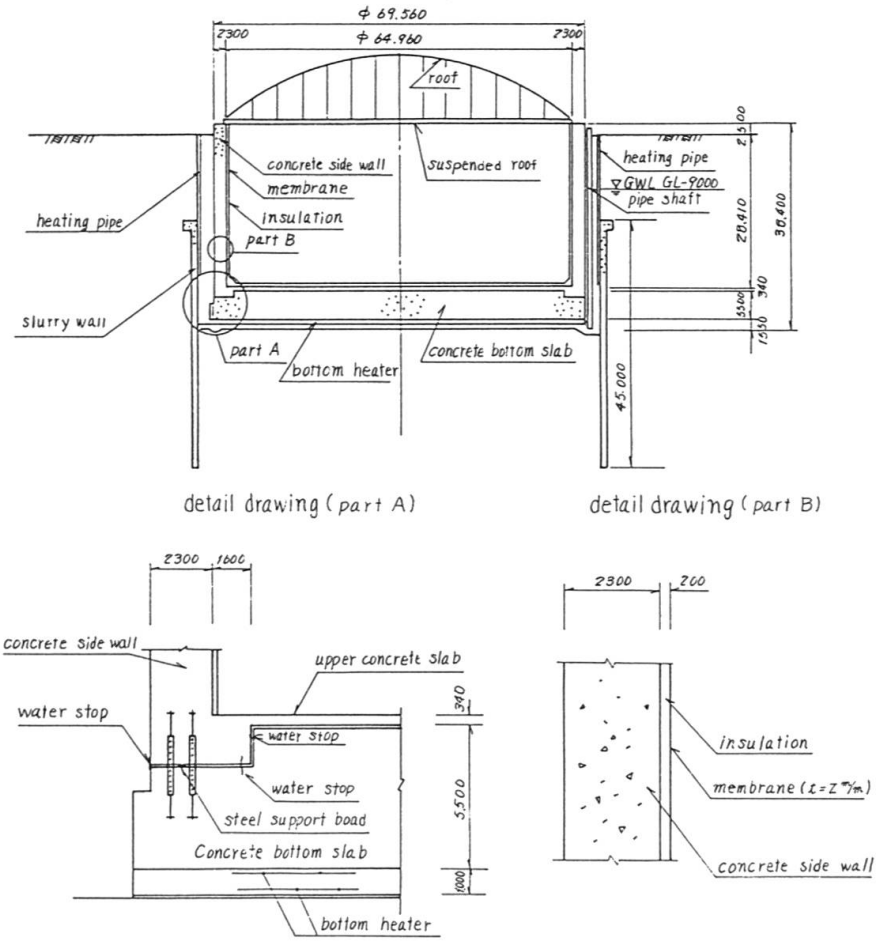

Fig. 1 Cross section with details

Fig. 2 Aerial view