

Overview of Spent Fuel Pool Design for the APR1400

1. Introduction
2. Codes and Standards
3. Load and Load Combinations
4. Analysis
5. Design

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1. Introduction

- The purpose of this presentation is to present an overview of the analysis and design of the APR1400 spent fuel pool (SFP).

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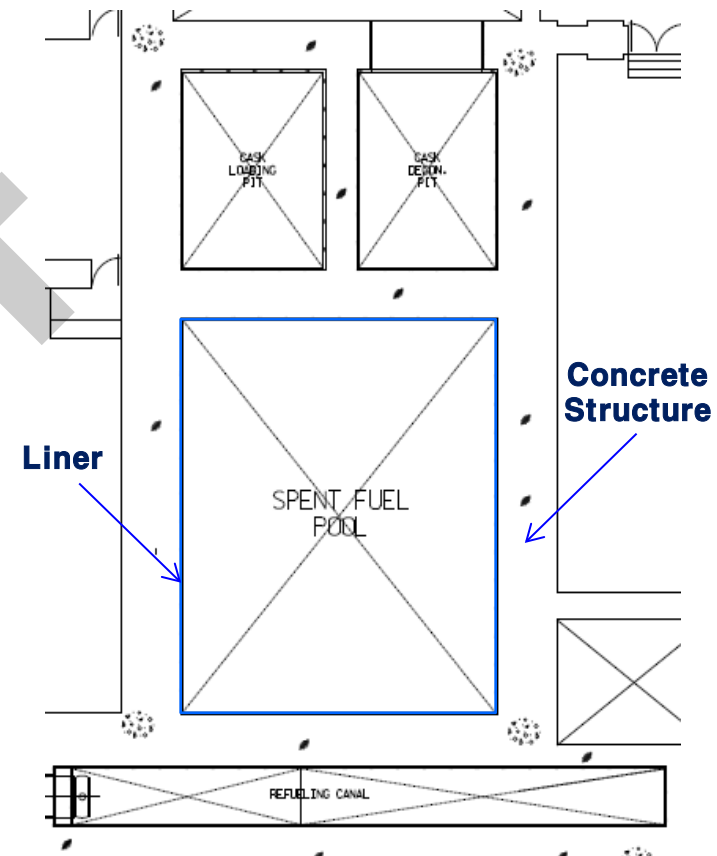
1) SFP Configuration

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2) Description of SFP

- 35 ft x 42 ft x 42 ft with a depth of 42 ft (EL.114'- 0" to 156'- 0")
- Interior surface - stainless steel liner plates
- Liner system and its anchorage system for form work and leak tight membrane

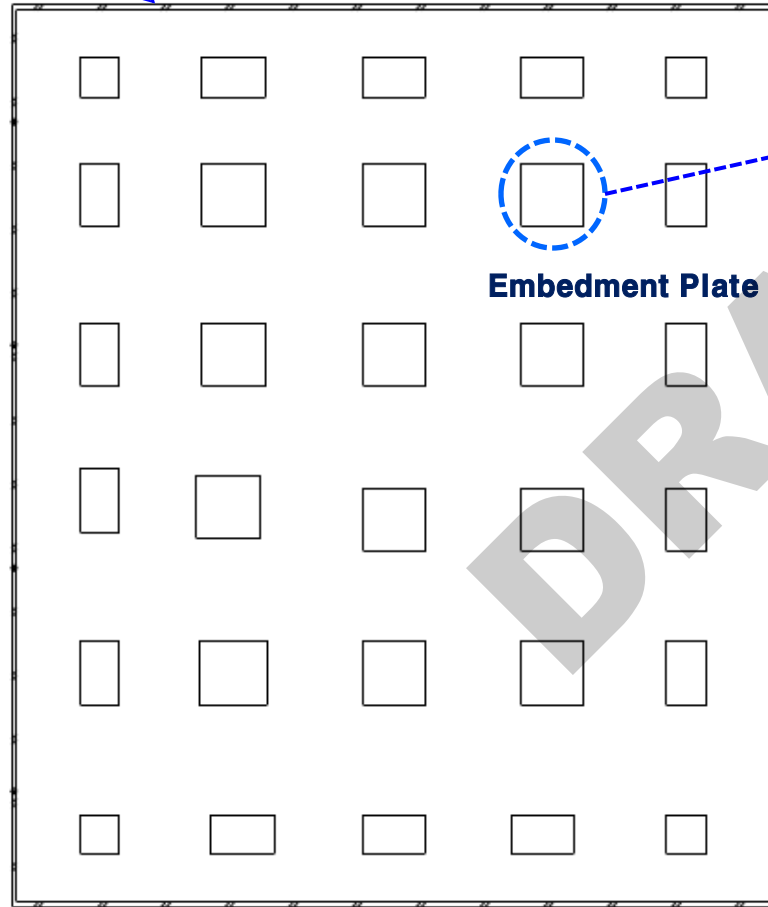


PLAN

2) Description of SFP (Cont'd)

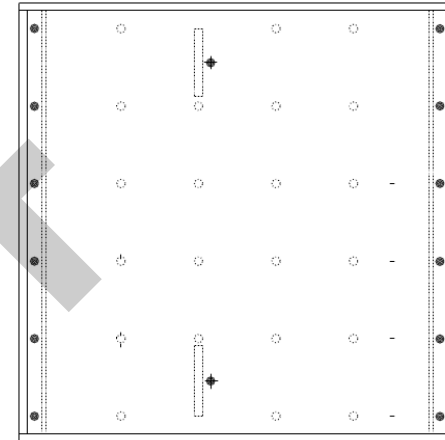
Liner

Details of
Shin-Kori units 3&4

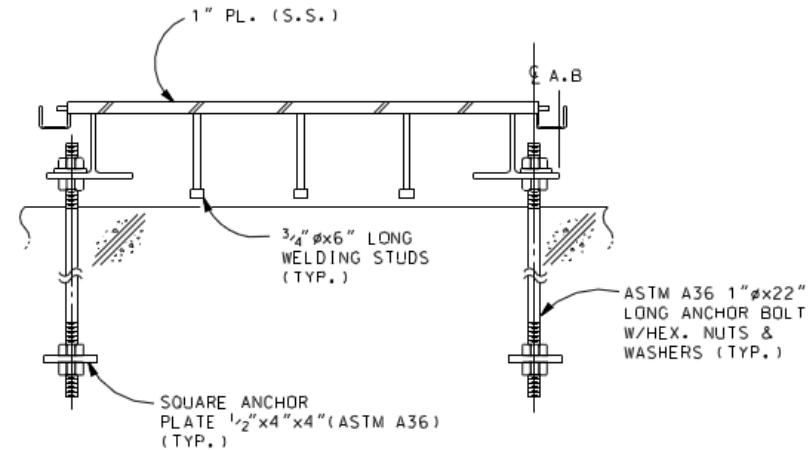


Embedment Plate

A



Detail of Embedment Plate



Section A

PLAN of SFP Floor

2. Codes and Standards

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2 Codes and Standards

- **ASME Section III, Division 2, Subsection CC**: Code for Concrete Containments, ASME, 2001 Edition with the 2003 Addenda
- **ACI 349**: Code Requirements for Nuclear Safety-Related Concrete Structures, ACI, 1997, including Appendix B (2001)
- **AISC N690**: Specification for the Design, Fabrication, And Erection of Steel Safety-related Structures for Nuclear Facilities, including Supplement 2 (2004), ANSI/AISC, 1994

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3. Loads and Load Combinations

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1) Loads

- Dead Load (D)
- Hydro-static Loads (L_h)
- Thermal Loads due to Spent Fuel Decay Heat (T_o , T_a)
- Safety Shutdown Earthquake including Hydro-dynamic Water Pressure (E_s)

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2) Load Combinations

- Concrete Structure Design
 - ✓ Normal Condition : $1.1 D + 1.1 L_h + 1.2 T_o$
 - ✓ Abnormal Condition : $1.0 D + 1.0 L_h + 1.0 T_a$
 - ✓ Abnormal/Extreme Environmental
: $1.0 D + 1.0 L_h + 1.0 T_a + 1.0 E_s$
- Liner Design
 - ✓ Normal Condition : $1.0 D + 1.3 T_o$
 - ✓ Abnormal Condition : $1.0 D + 1.0 T_a$

4. Analysis

- 1) Global Structural Analysis
- 2) Thermal Analysis
- 3) Hydro-dynamic analysis

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1) Global Structural Analysis

This analysis is performed to compute all member forces of shear walls in the AB.

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1) Global Structural Analysis (Cont'd)

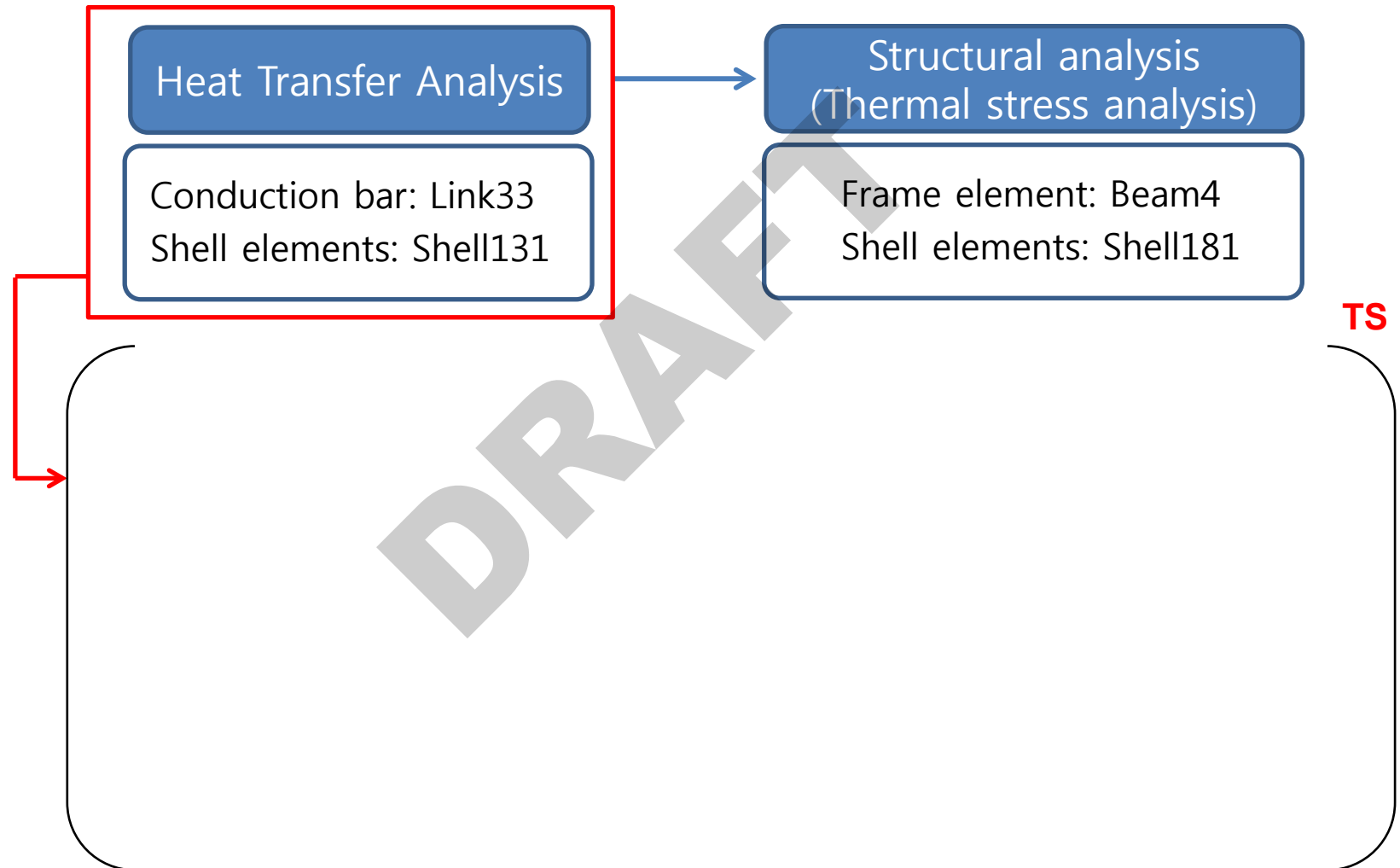
- Accidental Torsion
 - Accidental torsional moment : Story inertia force X 5% of the building plan dimension
 - Accidental torsional moments are applied at the mass center of each floor elevation.

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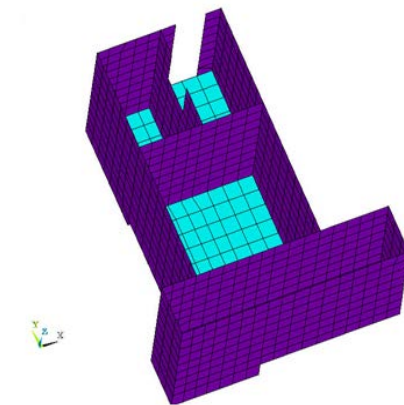
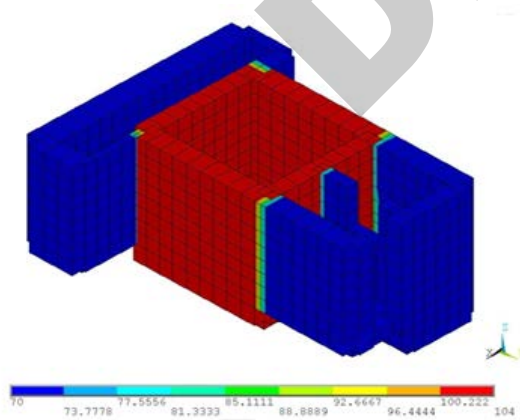
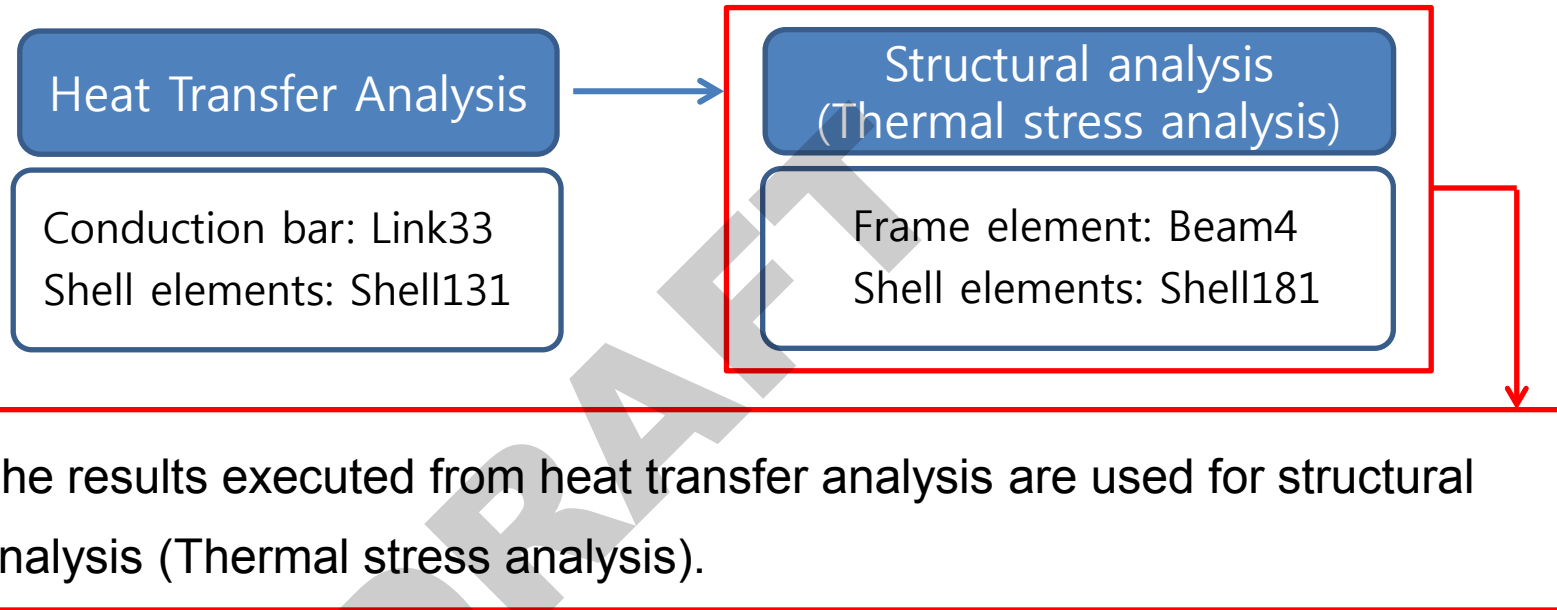
2) Thermal analysis

- For thermal analysis, following stage is considered.



2) Thermal analysis (cont'd)

- For thermal analysis, following stage is considered.

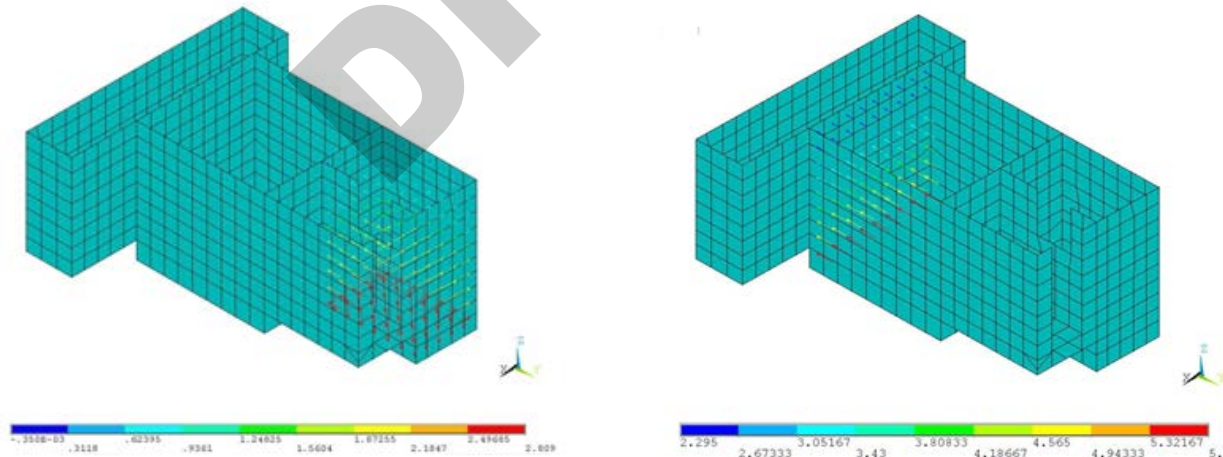


3) Hydro-dynamic analysis

- The purpose of analysis is to perform the structural analysis considering water pressures (Hydro-static load, Hydro-dynamic load)

Load	Remark
Hydro-static load	$P = \gamma_w \times \Delta H$
Hydro-dynamic load	Hydro-dynamic pressure corresponding to the impulsive, convective and wall inertia are defined according to code TID-7024.
Analysis method	Modal analysis (for Fundamental period), Static analysis (for Member force)

- These loads are applied to the surface of SFP, Cask loading pit and Refueling Canal FE model as surface load.



5. Design

- 1) Concrete Structure Design
- 2) Liner Design

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1) Concrete Structure Design

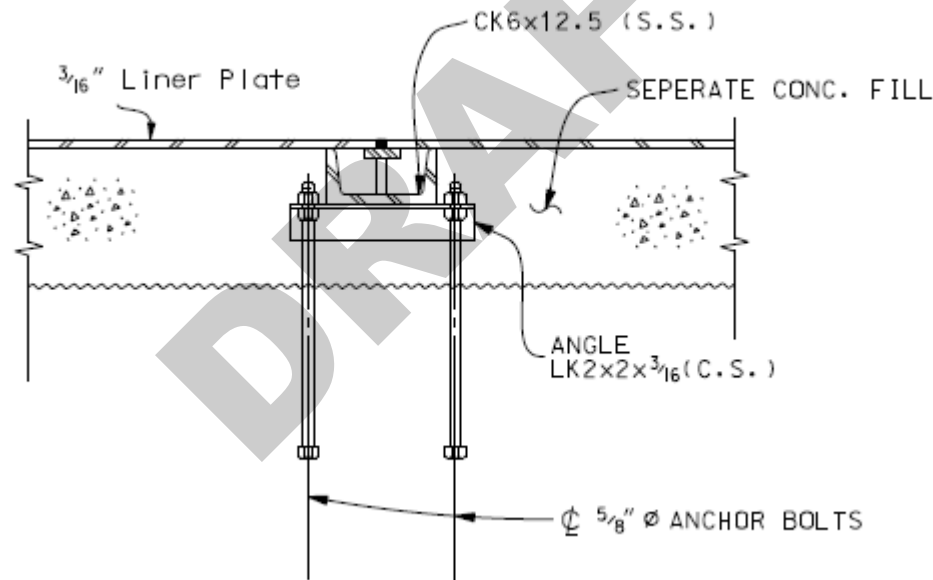
West Wall of SFP

- ✓ Dimension : EL.114 ft. to EL.156 ft. in 7 ft. thickness
- ✓ Max. re-bar arrangement : 2#14 @ 9" in horizontal direction
- ✓ Max. shear re-bars : #5 @ 12"

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2) Liner Design

- Form type of 1/4 inch thickness (wall)
- Wallpaper type of 3/16 inch thickness (slab)
- Leak Chase System



Details of Shin-Kori units 3&4