

2D 3D

**The Comprehensive Analysis on the Thermo-mechanical Behavior
of the Assembly Ducts by 2D and 3D Code**

150

					2
	NUBOW2D-KMOD	3	CRAMP		2
3	1		2		
	3				
			3		2

Abstract

In the design of LMR assembly duct, it is necessary to analyze the thermo-mechanical behavior of the assembly ducts due to the bowing and swelling of the assembly duct. Two codes are available for the thermo-mechanical analysis of the duct in KALIMER, which are the 2D code (NUBOW2D-KMOD) and the 3D code (CRAMP). In this study, the first order creep equation installed into 3D code is corrected by the analysis of the 2D code. And in the analysis of the 2D code, the new analytical results for 2D code are derived by changing input condition in order to get the similar results compared with the analysis of the 3D code. These new results are used for the analysis of the contact pattern between the ducts and the reactivity feedback which are the main issues for the core mechanical analysis. So, the best estimate results for the core mechanical analysis can be derived from the comprehensive analysis on the thermo-mechanical behavior of the assembly ducts by 2D and 3D code.

1.

NUBOW2D- KMOD 3 CRAMP 2

. 2

, 3

가 가

가 가 , 2 3

가

3 HT9

2 ,

2 3

2.

/

Pad 가,

가, 가,

가, 가 가

(, , , ,

), (Pad , Pad , , ,

Receptacle, , Core former), (, , , ,

), (2 , 3)

NUBOW2D- KMOD¹⁾

(NUclear fuel BOWing 2Dimensional analysis code- Kaeri MODE) CRAMP²⁾ (Core

Restraint Analysis Modeling Program) 가

NUBOW2D- KMOD ANL NUBOW -2D Inelastic 2

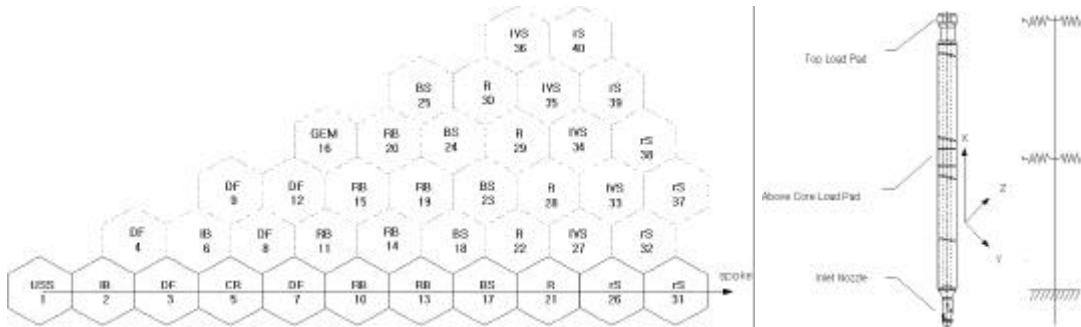
. Source Program 가 ,

2 가

CRAMP AEAT가 3

가 , Binary

1
 3). 2 spoke , 3
 2 row
 , 3



1.

3. 2D 3D

3D CRAMP 가 , 가
 . 2D NUBOW2D-KMOD 가
 2D 3D

- 2D 3D HT9

HT9

4).

$$\epsilon = [-2.9 + 9.5 \times 10^{-3} \times (T - 273)] \times 10^{-26} \Phi t \sigma_e^{1.3} + 1.743 \times 10^{18} \left[\frac{\sigma_e}{E(T)} \right]^{2.3} \exp\left(-\frac{36739}{T}\right) t$$

: (n/cm²s)
 T : (K)
 σ_e : 가 (MPa)
 E(T) : (MPa)

2 , 3
 1 . 3D CRAMP 1

가 가

3D

1
1

1

$$\epsilon = A * [4.01823 \times 10^{-6} T + (-1.2266 \times 10^{-3}) \sigma]$$

ϵ : (% per dpa),

T : ()

σ : 가 (Mpa)

A 100dpa= 10^{24} n/cm² 가 CRAMP

가 2D

2 50

A

3 540

400dpa= 10^{24} n/cm²

(PRISM)

200dpa= 10^{24} n/cm² 가

A 200dpa= 10^{24} n/cm²

0.5, 400dpa= 10^{24} n/cm²

0.25가

가

A = 0.25 가

3D

A 0.25

(540

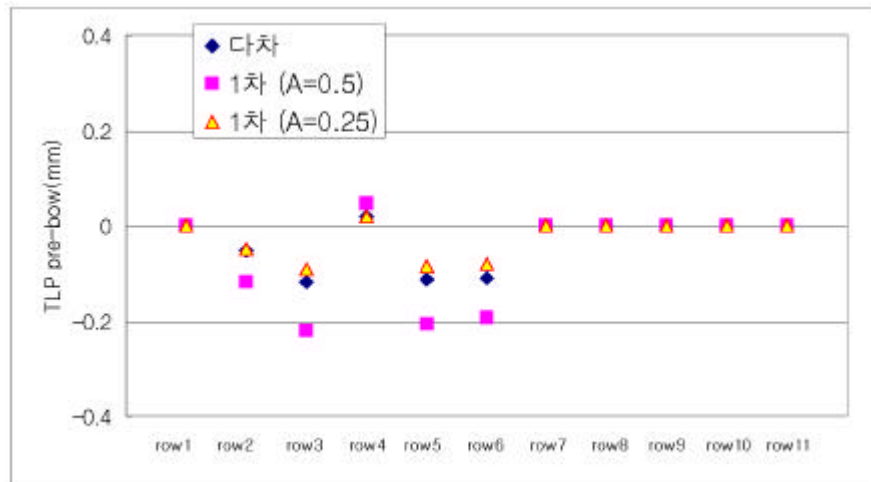
, A=0.25) : 0.22mm가

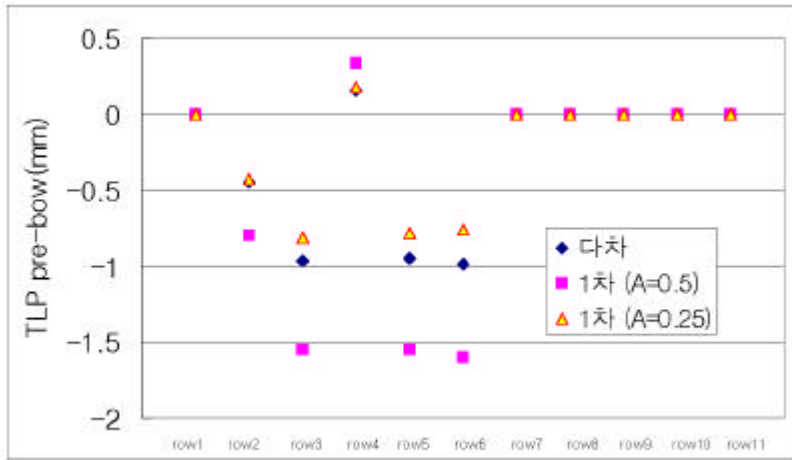
2D 3D

, 3D

가 2D

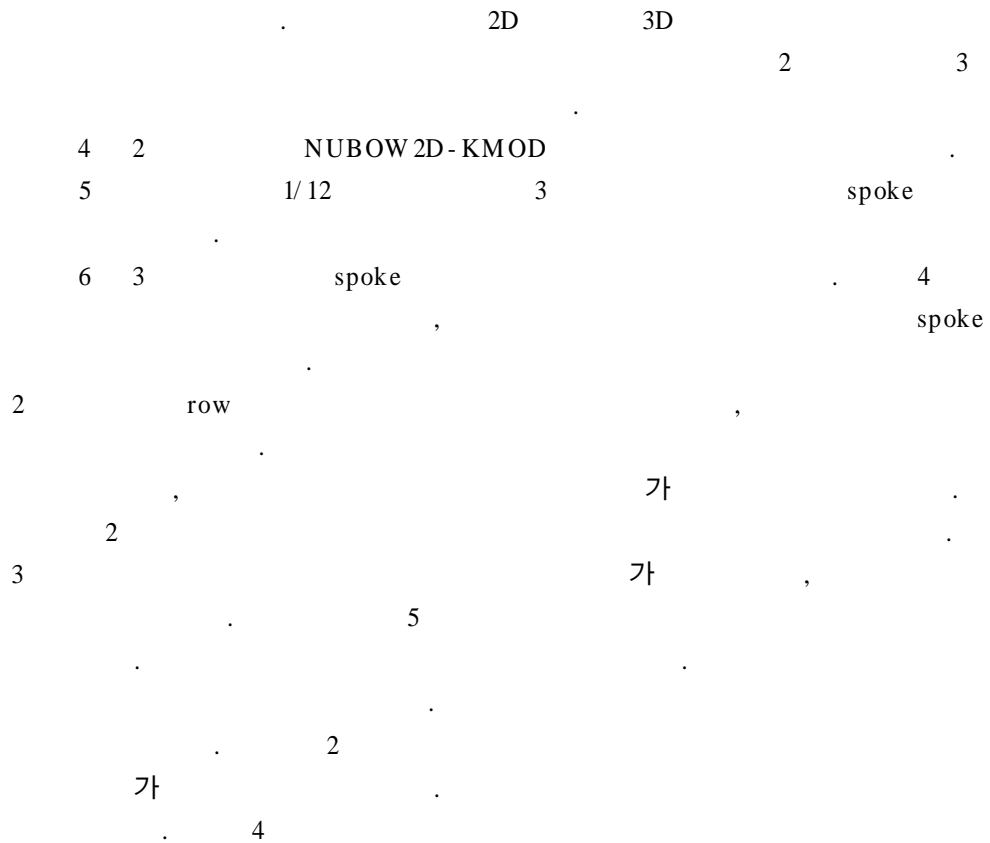
3D

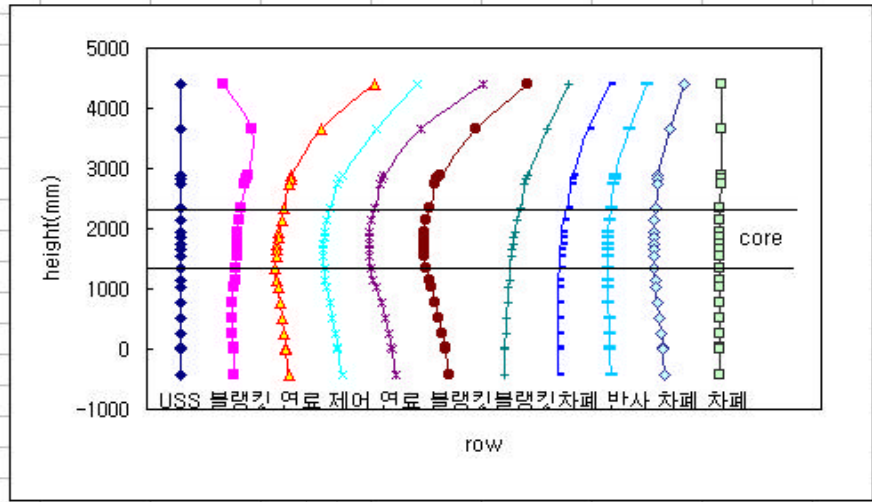




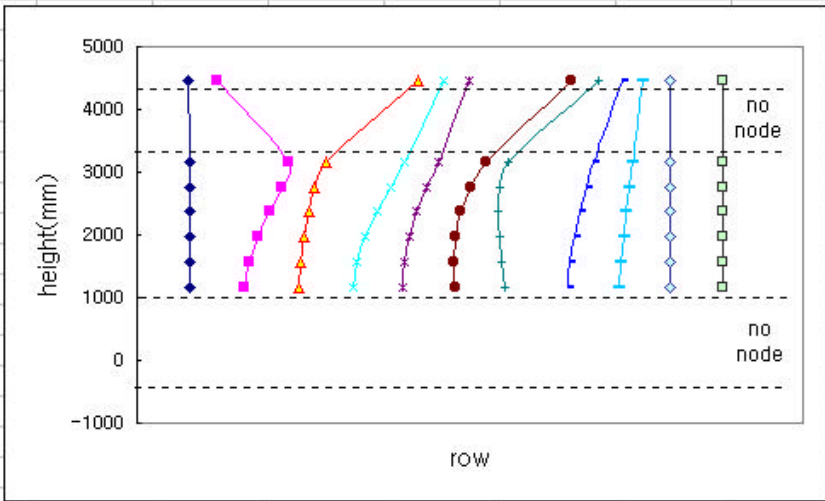
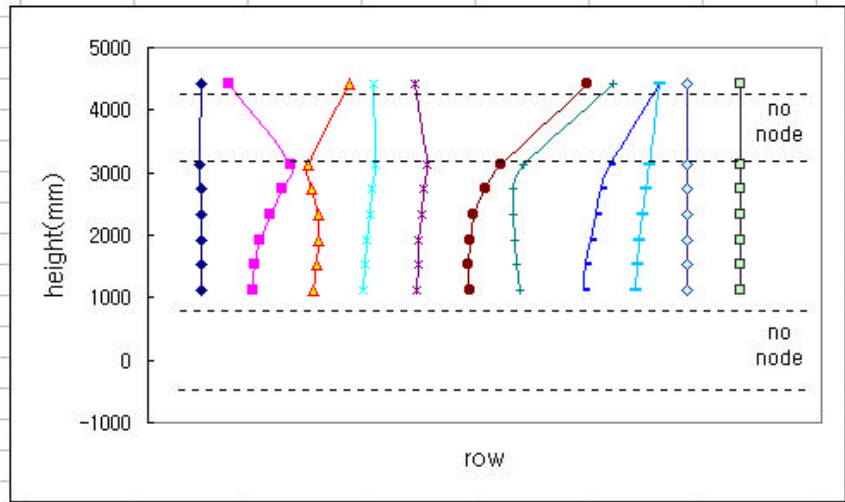
3 540

- 2D 3D





4. 2D



6. 2D

3D

- 3D

2D

2

3

3

2

가

2

3

가

6

2

3

가

pad

가

pad

pad

1mm

가

가

가

가

ACLCP

6 row

ACLCP

pad

pad

가

7

1mm

pad 가

가

0.4mm

2

NUBOW 2D-KMOD

8

pad가

1mm

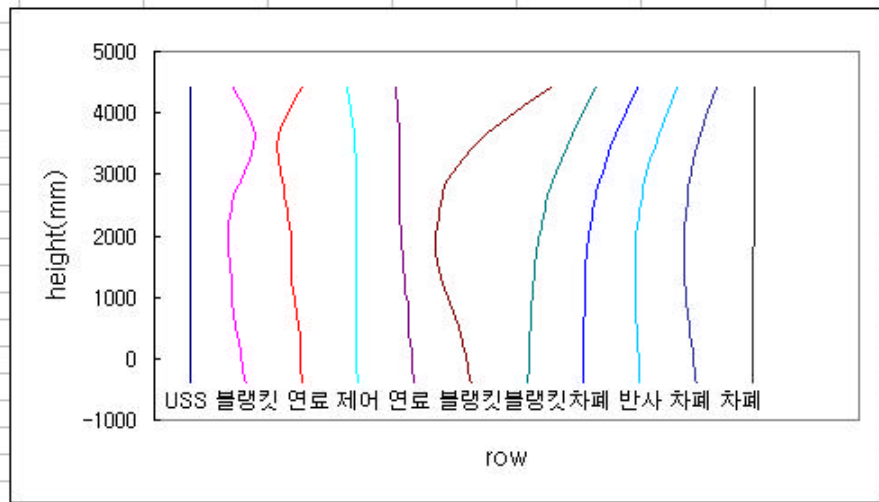
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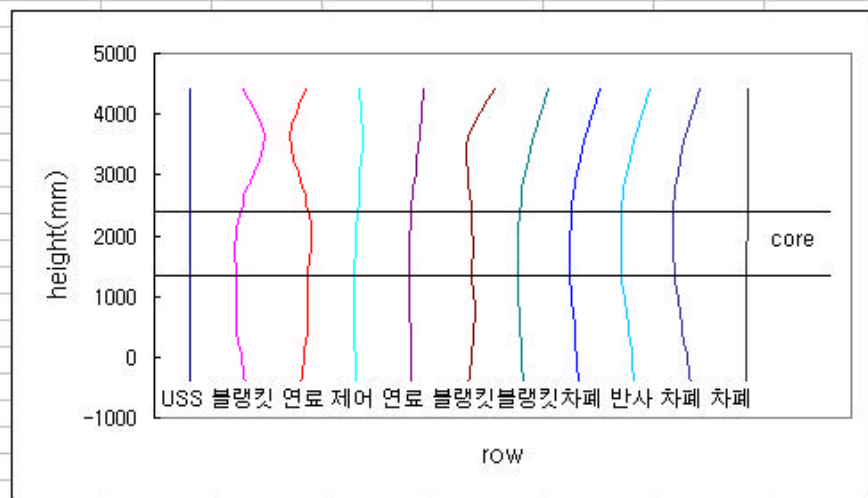
0.4mm

pad

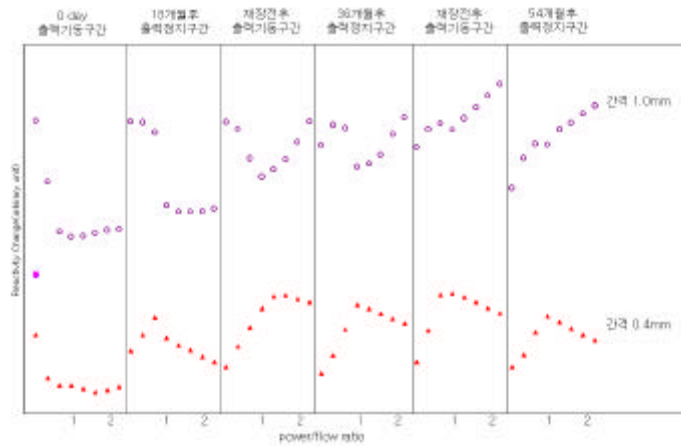
가 pad



7. 2D

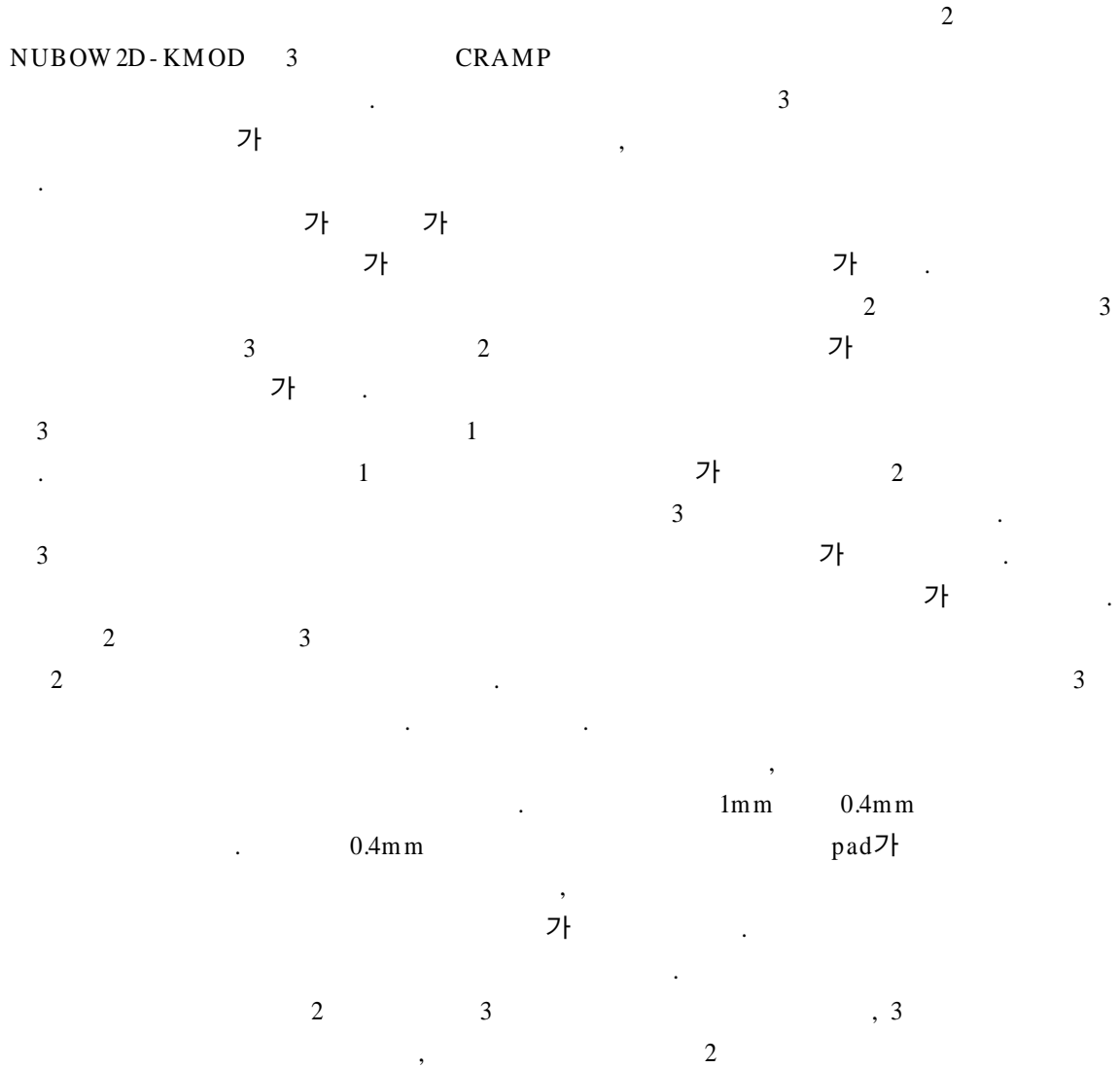


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