

# Midas Civil 2022 v1.1 개정내용

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Release Date : Nov. 2022

Product Ver. : Civil 2022 (v1.1)

**DESIGN OF CIVIL STRUCTURES**

Integrated Solution System for Bridge and Civil Engineering

# Enhancements

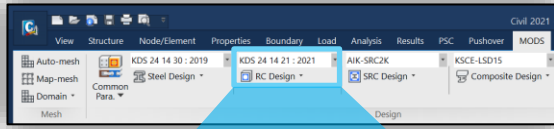
1. KDS설계기준 업데이트
  - KDS 24 14 21(콘크리트/PSC 한계상태설계법) 탑재
2. 응답변위하중에 대한 하중 재하 기능 탑재
3. Earthquake Scaling 기능 추가



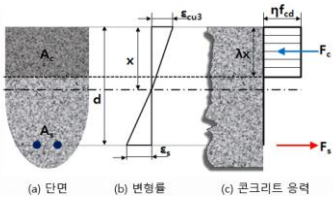
# 1. KDS 설계기준 업데이트

- KDS 24 14 21(한계상태설계법)에 의한 Detail Report Renewal (기준 근거 명시)
- 고강도 콘크리트에 대한 휨강도 계산 반영

## MODS > Design > RC Design, PSC > PSC Design



KDS 24 14 21 : 2021  
RC Design



$f_{ck}$ (MPa)	18	21	24	27	30	35	40	50	60	70	80	90		
$n$	2.0			1.92			1.5			1.29			1.22	
$\epsilon_{cu}$	2.0			2.1			2.2			2.3			2.4	
$\epsilon_{cu}$	3.3			3.2			3.1			3.0			2.9	
$\epsilon_{cu}$													2.8	

콘크리트 강도에 따른 응력-변형률 곡선 계수 (KDS 24 14 21 : 2021 3.1.2.5)

$n$ (상승곡선부 형상지수)	=	2
$\epsilon_{cu}$ (극한 변형률)	=	0.00330
$\alpha$ (압축압력 크기계수)	=	0.798
$\beta$ (압력 작용점 위치계수)	=	0.400
$\eta$ (응력 블록의 응력 크기 계수)	=	1.000

### 2. 휨강도 검토 (KDS 24 14 21 : 2021 4.1.1.2)

2.1 최소철근량 검토

인장철근 검토

$$reqA_s = \frac{f_{yd} \cdot d \cdot \sqrt{(f_{yd} \cdot d)^2 - f_{yk}^2 / (\eta \cdot f_{cd} \cdot b_w)} + 2M_u}{f_{yk} \cdot \eta \cdot f_{cd} \cdot b_w} = 6677.194 \text{ mm}^2$$

$$maxA_s = 0.04 \cdot b_w \cdot d = 36000.000 \text{ mm}^2$$

$$minA_{s1} = (0.25 \cdot \sqrt{f_{ck} / f_y}) \cdot b_w \cdot d = 3674.235 \text{ mm}^2 \text{ (KDS 24 14 21 : 2021 4.6.2.1(4.6-1))}$$

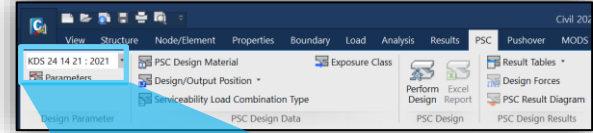
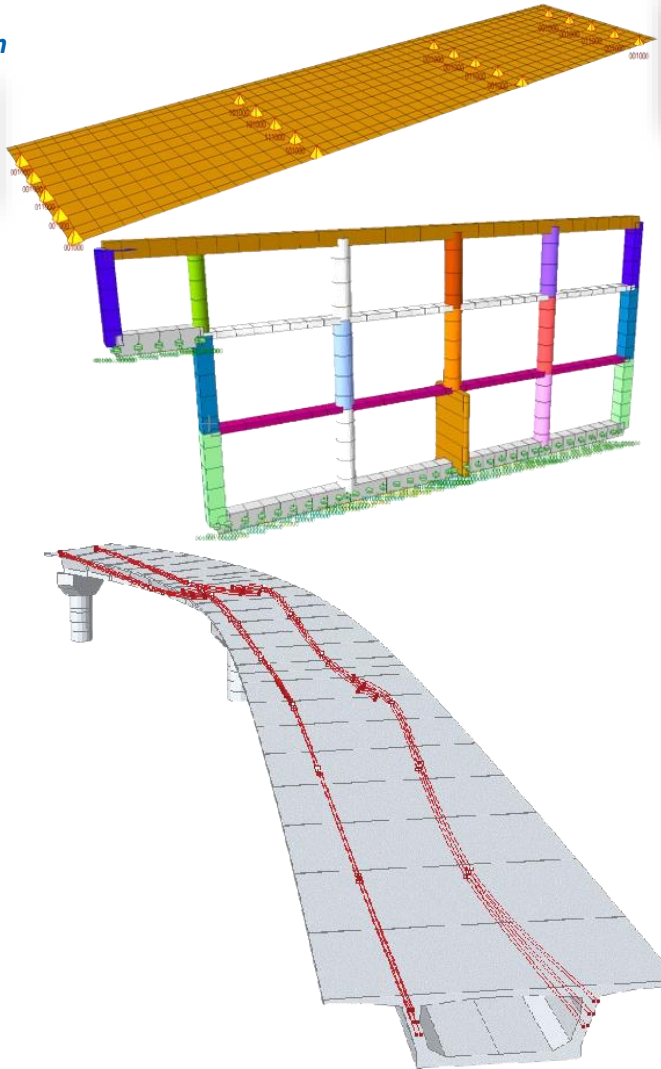
$$minA_{s2} = (1.4 / f_y) \cdot b_w \cdot d = 4200.000 \text{ mm}^2 \text{ (KDS 24 14 21 : 2021 4.6.2.1(4.6-2))}$$

$$minA_s = \text{MAX} [ minA_{s1} ; minA_{s2} ] = 4200.000 \text{ mm}^2$$

$maxA_s$ (mm <sup>2</sup> )	$minA_s$ (mm <sup>2</sup> )	$reqA_s$ (mm <sup>2</sup> )	$(4/3)reqA_s$ (mm <sup>2</sup> )	$useA_s$ (mm <sup>2</sup> )
36000.000	4200.000	6677.194	8902.925	3096.800

사용철근량  $useA_s$

1단 : D22 - 8.00EA = 3096.80 mm<sup>2</sup>



KDS 24 14 21 : 2021

Parameters

설계기준: KDS 24 14 21 : 2022

실제계산 입력변수

전단강도  
Strut angle for shear resistance: 45 (Degree)

시멘트 구분  
[1종 시멘트 습윤 양생(0.3)]  
[사용자 입력 데이터] Modify design parameters.

콘크리트 응력 계산  
 Rectangular Stress Block  
 Stress-Strain(Parabolic-Plateau)

출력 입력변수  
극한한계상태 사용한계상태

No.	중합축(c) (mm)	입축력 (C) (kN)		인장력 (T) (kN)		Ratio (C/T)
		종공리트(F <sub>c</sub> )	횡공리트(F <sub>s</sub> )	종공리트(F <sub>c</sub> )	횡공리트(F <sub>s</sub> )	
9	83.533	2485.920	0.000	2508.408	1354.000	0.99103
10	85.731	2651.339	0.000	2508.408	1354.000	1.01711
11	84.632	2618.629	0.000	2508.408	1354.000	1.00407
12	84.083	2502.274	0.000	2508.408	1354.000	0.99755
13	84.358	2510.452	0.000	2508.408	1354.204	1.00081

중합축 검토 (KDS 24 14 21 : 2022, 4.6.2.1C)

$C_{min} = (\delta \cdot \epsilon_{cu} / 0.0033 - 0.6) \cdot d = 765.340 \text{ mm} > c = 84.358 \text{ mm}$

여기서,  $C_{min}$  = 극한한계상태에서의 최대 중합축 길이

$\delta$  = 요면트 자분비 후의 계수(요면트/탄성요면트 비율, 요면트 자분비하지 않는 경우  $\delta=1$ )

$d = 1913.350 \text{ mm}$  : 단면의 유효깊이

$\epsilon_{cu}$  = 콘크리트의 극한변형률 (KDS 24 14 21 : 2022, 표 3.1-3)

$$= 0.0033 \cdot \left( \frac{f_{ck} - 40}{100000} \right) \leq 0.0033 \quad ; \epsilon_{cu} = 0.0033$$

축력  $F_{csp}, F_{csp}, F_{s,sp}$  계산

$F_{csp} = (\eta_{sp} \cdot F_{csp}) \cdot A_{csp} = 0.000 \text{ kN}$  : 거더의 압축력

$F_{s,sp} = (\eta_{sp} \cdot F_{s,sp}) \cdot A_{s,sp} = 2510.452 \text{ kN}$  : 슬래브의 압축력

$F_{c} = f_c \cdot A_c = 0.000 \text{ kN}$  : 횡공에 의한 압축력

$F_s = f_s \cdot A_s = 2508.408 \text{ kN}$  : 횡공에 의한 인장력

$F_{sp} = \sum F_i = 0.000 \text{ kN}$  : 긴장재에 의한 인장력

여기서,  $a = 2 \cdot \beta \cdot c = 67.486 \text{ mm}$  : 등가사각 블록의 높이

$c = 84.358 \text{ mm}$  : 중합축 길이

$\beta$  = 장요면트에서는  $\beta_{sp}$ , 부요면트에서는  $\beta_{cp}$

$\beta_{sp} = 0.400$  : 거더에서 압축영역 유효높이 계산을 위한 계수

$\beta_{cp} = 0.400$  : 슬래브에서 압축영역 유효높이 계산을 위한 계수

$\eta_{sp} = 0.997$  : 거더의 등가사각 블록 크기 계수

$\eta_{cp} = 0.997$  : 슬래브의 등가사각 블록 크기 계수

$A_{csp} = 0.000 \text{ mm}^2$  : 등가사각 블록에서 거더에 해당하는 콘크리트면적

$A_{s,sp} = 168715.088 \text{ mm}^2$  : 등가사각 블록 높이에서 슬래브에 해당하는 콘크리트면적

휨강도 계산

$M_u = F_{csp} \cdot a_{sp} + F_{c,sp} \cdot a_{cp} + F_s \cdot a_s + \sum (F_{pi} \cdot a_{pi})$

$= 3028.929 \text{ kN} \cdot \text{m} \geq M_{u,sp} = 3015.133 \text{ kN} \cdot \text{m}$

여기서,  $a_{sp}, a_{cp}, a_s, a_{pi}$ 는 중합축에서 각 축력물까지의 거리

## 2. 응답변위하중에 대한 하중 재하 기능 탐색

- 지중구조물의 지진하중으로 재하되는 응답변위법에 의한 지반변위하중 자동재하 (Frame/Planar Structure 모두 고려 가능)
- 지반층이 1개일 경우에 적용되는 단일 코사인 방법과 다수일 경우 적용되는 이중 코사인 방법 제공

### Static Load > Lateral Load > Seismic Earth Pressure

Seismic Earth Pressure

Load Case Name : NLC

Option  
 Add/Replace  Delete

Loading Type  
 Type : Planar  
 Width : 0 m

Direction : X-Y  
 Angle : 0 [deg]  
 Inner Pt : 0, 0, 0 m  
 Scale Factor : 1

Seismic Load Code : KDS(17-10-00:2018)

Parameters of Seismic Load : **불교방직수준**

Layer Parameter  
 Single Cosine  
 Double Cosine  
 Top Level of 2nd Layer : 0 m  
 User

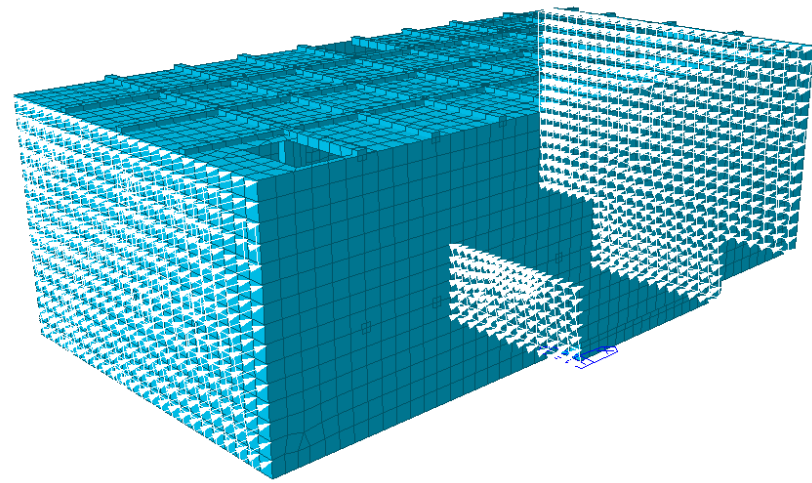
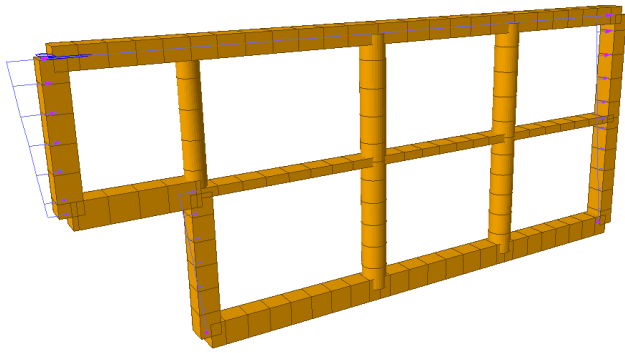
Parameters of Soil Properties : **Soil(Single)**

Element Type  
 Frame  Planar

Elements Defining Loading Area :

Seismic Earth Pressure Profile...

Apply Close



Add/Modify Parameter of Seismic Load(For Earth Pressure)

Seismic Load Name : 불교방직수준  
 Seismic Load Code : KDS(17-10-00:2018)

Seismic Load Parameters  
 Design Spectral Response Acceleration  
 Seismic Zone (Z) : Zone(0,1,1)  
 Seismic Risk Factor (I) : 1.4  
 Site Class : S1  
 Damping Ratio : 0.2

OK Cancel Apply

Design Spectrum 정의

Parameters of Soil Properties

Soil Properties Name : Soil(Single)  
 Description : Single Cosine

Soil Levels  
 Ground Level : 0 m Bottom Level of Footing : -2.25 m  
 Backfill Level : -4 m

Soil Parameters  
 Height-Add/Delete  
 Height : 10 m No. of Copies : 1

No.	Level (m)	Height (m)	Density (kN/m³)	Poisson Ratio	γs (kN/m³)	Kh (kN/m³)	Rel.Dens
1	20.00	10.00	18.00	0.35	162.00	20250.00	0.9479
2	2.00	-4.00	18.00	0.32	162.00	20250.00	0.9479

OK Cancel Apply

Soil Profile 정의

Seismic Earth Pressure Profile

Select Profile  
 Coeff. of Horizontal Ground Reaction Force(s)  
 Relative Earth Displacement  
 Design Seismic Earth Pressure

Level (m)	Kh (kN/m³)	Relative Earth Displacement (m)	Design Seismic Earth Pressure (kN/m²)	Additional Pressure (kN/m²)
1	20,000	20,950.2551	0.0108	305.7888
2	12,000	20,950.2551	0.0068	205.7718
3	10,000	20,950.2551	0.0078	220.4344
4	4,000	20,950.2523	0.0030	109.7047
5	2,000	20,950.2633	0.0020	58.0528
6	-2,250	20,920.2633	0.0000	0.0000
7	-4,000	20,920.2633	0.0000	0.0000
8				

File Name : C:\W01\live\001\_지진오염방지\_C44\_교량의기둥\_토목역사\_인도네시아\_40\_Auto-mesh\_인용한  
 Make Seismic Soil Load Calc. Sheet

OK Cancel

Soil Profile에 따른 Seismic Earth Pressure 확인

SEISMIC EARTH PRESSURE (DOUBLE COSINE METHOD) [UNIT : kN, m]

1. PARAMETERS OF SEISMIC LOADS

Seismic Load Name : 불교방직수준  
 Seismic Zone : 1  
 Seismic Risk Factor : 1.4  
 Effective Ground Acceleration : 0.154  
 Site Class : S1  
 Damping Ratio : 0.200

2. CALCULATE AVERAGE SHEAR WAVE VELOCITY

H1 = 10,000 m  
 VsH1 = 192.066 m/sec  
 GAMA.1 = 18,000 kN/m²  
 H2 = 14,000 m  
 VsH2 = 192.066 m/sec  
 GAMA.2 = 19,000 kN/m²  
 ALPHA = GAMA.1 + VsH1 / (GAMA.2 + VsH2) = 0.947  
 tESAO = 13.822 sec  
 tS = 0.252 sec

3. CALCULATE THE ACCELERATION RESPONSE SPECTRUM OF GROUND

t1 = 0.060 sec  
 t2 = 0.200 sec  
 t3 = 1.000 sec  
 Sa = 1.143 m/sec²

4. CALCULATE THE VELOCITY RESPONSE SPECTRUM OF BED ROCK

Gd = 0.561  
 Sv = 7/(2\*Gd) \* Sa \* Gd = 0.113 m/sec

5. CALCULATE DISPLACEMENT OF GROUND (u(z))

Sv = 0.113 m/sec  
 t4 = 0.252 sec  
 H1 = 10,000 m  
 H2 = 14,000 m  
 u(z5) = 0.003 m

6. SEISMIC EARTH PRESSURE PROFILE

Scale Factor : SF = 1.000

LEVEL (m)	Kh (kN/m³)	u(z)=u(z5) (m)	Kh(u(z)-u(z5)) (kN/m³)	ADDITIONAL (kN/m²)
20.000	20,000.000	0.011	306.789	0.000
12.000	20,950.252	0.009	205.771	0.000
10.000	20,950.252	0.009	220.434	0.000
4.000	20,950.263	0.004	109.705	0.000
-2.250	20,950.263	0.000	58.053	0.000
-4.000	20,950.263	0.000	0.000	0.000

Seismic Earth Pressure 계산

### 3. 지진파 스케일링 기능 탑재

- 실지진파에 대한 Scaling 기능으로 해당 지역의 설계 스펙트럼을 기반으로 지진파를 조정하는 기능
- Earthquake Scaling을 조정하는 방법으로 진폭(Amplitude), 주기(Frequency)를 제공

Tools > Generator > Earthquake Scaling Calculator

**Input Data**

Earthquake

Define Earthquake Functions

	Earthquake 1	Earthquake 2
1	Elcent_1	Elcent_2
2	Elcent_3	Elcent_4
3		

Damping Ratio : 0.05

**Target Spectrum**

Define Design Spectrum

Apply the Same Amplification Factor 1

	Period (Sec)	Amplification factor
1	0.0000 ~ 0.0827	1.0000
2	0.0827 ~ 0.4136	1.0000
3	0.4136 ~ 6.0000	1.0000

**Target Period**

	Period (Sec)
1	0.0000 ~ 6.0000
2	

Earthquake Scaling Control

Method:  Amplitude  Frequency  Auto  User

Scale Factor:

Calculate

**Result Graph**

Graph Type:  Spectrum  Acceleration

Earthquake Name: All

Spectral Data

Period (sec)

Legend: Target Spectrum (red), Design Spectrum (black), Average SRSS (blue)

Export Results to T.H Funcs. | Export Results to SCS files | Export Results to Excel

Generate Design Spectrum

Design Spectrum : KDS(17-10-00:2018)

Design Spectral Response Acceleration

Seismic Zone (Z) : Zone1(0.11)

Seismic Risk Factor (I) : 1.4

Site Class : S3

Seismic Coefficient(Fa) : 1.59200

Seismic Coefficient(Fv) : 1.64600

Max. Period : 6 (Sec)

OK | Cancel

Add Modify/Show Time History Functions

Function Name: Elcent\_1,1

Time Function Data Type:  Normalized Accel.  Acceleration  Force  Moment  Normal

Scaling:  Scale Factor  Maximum Value

Scale Factor: 1 | Maximum Value: 9

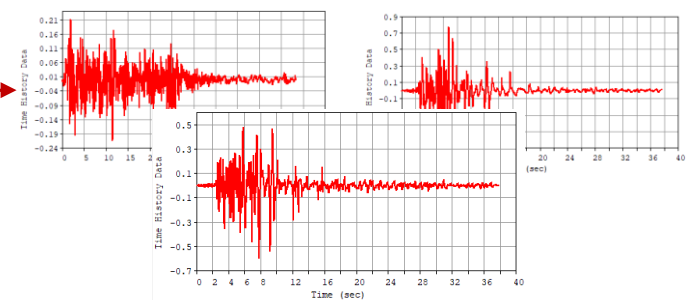
Gravity: 9.80665 m/sec<sup>2</sup>

Graph Options:  X-axis log scale  Y-axis log scale  FFT

Time History Data

Time (sec)

Generate Earthquake Response Spectrum... | OK | Cancel | Apply



주기 영역별로 증폭계수를 정의 가능

지진파를 조정하는 Target Period를 정의