

## ANALYSIS OF QMQ 2.01.03-19 STANDARD FOR ANTI-SEISMIC DESIGN OF BUILDINGS IN STRONG EARTHQUAKE EPICENTERS

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**Abstract:** This study analyzes the application of QMQ 2.01.03-19 standards in designing buildings in high seismic hazard zones of Uzbekistan, particularly in epicentral zones. Epicentral zones are areas within a 20-30 km radius from the earthquake epicenter where seismic impact reaches maximum intensity. The research findings revealed that in 9\* intensity zones, the seismic load coefficient increases 8 times compared to 7 intensity zones, and building height decreases from 56 meters to 12 meters (from 16 stories to 3 stories). Spectral and dynamic calculation methods, as well as reinforcement requirements for anti-seismic belts and columns were studied.

**Keywords:** epicentral zone, anti-seismic design, QMQ 2.01.03-19, seismic load, 9\* intensity zone, spectral calculation, reinforcement.

### KUCHLI ZILZILALAR EPITSENTRIDA BINOLARNI ANTISEYSMIK LOYIHALASHDA QMQ 2.01.03-19 NORMASI TAHLILI

**Annotatsiya:** Tadqiqotda O'zbekistonning yuqori seysmik xavfli hududlarida, xususan epitsentral zonalarda binolarni loyihalashda QMQ 2.01.03-19 me'yoring qo'llanilishi tahlil qilindi. Epitsentral zonalar - bu zilzila epitsentridan 20-30 km radiusdagi, seysmik ta'sir maksimal bo'lgan hududlardir. Tadqiqot natijasida aniqlandiki, 9\* ball zonalarda seysmik yuk koeffitsienti 7 ball zonaga nisbatan 8 marta ortadi va bino balandligi 56 metrdan 12 metrgacha (16 qavatdan 3 qavatgacha) kamayadi. Spektral va dinamik hisoblash usullari, antiseysmik kamarlar hamda ustunlarning armaturalash talablari o'rganildi.

**Kalit so'zlar:** epitsentral zona, antiseysmik loyihalash, QMQ 2.01.03-19, seysmik yuk, 9\* ball zona, spektral hisob, armaturalash.

#### Relevance of the Topic

1. Uzbekistan is located in a high seismic hazard region
2. More than 70% of the territory is located in seismically active zones
3. Tashkent, Fergana Valley, Samarkand are located in high intensity zones
4. Construction challenges in epicentral zones



**Research objective:** Comprehensive analysis of the role and significance of QMQ 2.01.03-19 standard in anti-seismic design of buildings in epicentral zones.

**Tasks**

1. Identify the characteristics of epicentral zones
2. Analyze QMQ 2.01.03-19 requirements
3. Study anti-seismic design methods
4. Develop practical recommendations

Epicentral zone is an area within a 20-30 km radius from the earthquake epicenter, where seismic impact reaches maximum intensity.

**Characteristics:**

- Acceleration: from 0.481 g to 0.96 g
- Combination of vertical and horizontal stresses
- Short-duration but powerful impulses
- Risk of soil liquefaction

**Table 1. Classification (According to QMQ 2.01.03-19)**

Zone Type	Seismicity	Description
>9 intensity	Above 9 intensity	Soil category III, special measures
9* intensity	ZMEB zones	Magnitude $\geq 7.1$ , construction restricted

(ZMEB - Zones with probability of earthquake source formation with magnitude 7.1 and above)

**Structure and Purpose of QMQ 2.01.03-19**



## Standard Contents:

- Basic provisions (Section 1) - 11 pages
- Calculation methodology (Section 2) - 19 pages
- Structural requirements (Section 3) - 37 pages
- Engineering networks (Section 4) - 27 pages
- Strengthening (Section 5) - 3 pages
- Quality control (Section 6) - 3 pages

## Application of QMQ 2.01.03-19 in Construction

- Territories with seismicity  $\geq 7$  intensity
- New construction, reconstruction, strengthening
- All categories of buildings (Responsibility classes I-V)

## Specific Aspects of Design in Epicentral Zones

### Seismic Load Calculation (Section 2 Analysis)

**A) Spectral Method (p. 2.6b):** In calculations performed using the spectral method, the design seismic load applied to point k in the selected direction and corresponding to the i- th mode of natural vibrations of the building (structure) is determined by the following formulas:

$$S_{ik} = K_o \cdot K_n \cdot K_{et} \cdot K_p \cdot S_{oik}; \quad (1) \quad S_{oik} = \alpha \cdot Q_k \cdot W_i \cdot K_{\delta} \cdot \eta_{ik} \quad (2)$$

$S_{oik}$  - inertia force determined assuming elastic deformation of the structure;

$\alpha$  - coefficient determined according to the seismicity of the construction site;

$Q_k$  - building (structure) weight applied to point k of the design scheme, determined from design loads;

$W_i$  - spectral coefficient;

$K_{\delta}$  - dissipation coefficient;

$K_p$  - regularity coefficient;

$K_o$  - responsibility coefficient;



$K_{et}$  - coefficient determined depending on the number of stories of the building (structure);

$\eta_{ik}$  - coefficient dependent on the natural vibration mode shape and location of loads in the design scheme when the building (structure) vibrates in the  $i$ -th mode;

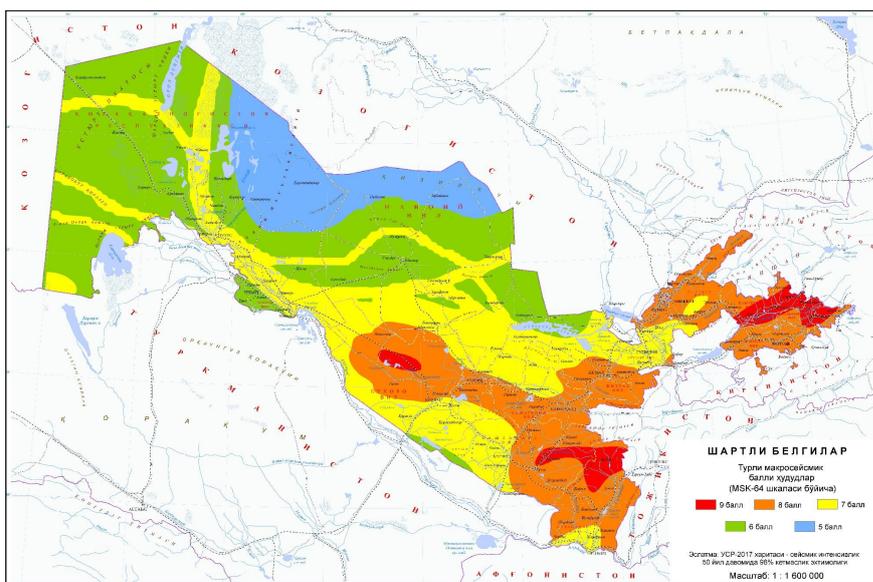
$K_n$  - coefficient accounting for earthquake recurrence.

### Key Parameters:

- $\alpha$  - site seismicity (7 intensity: 0.25; 9\* intensity: 1.0)
- 9\* intensity:  $\alpha = 2.0$  (8 times larger)
- Vertical component mandatory (70% of horizontal)
- Reduction coefficient:  $r = 1$  (no plastic deformation)

### B) Dynamic Method (p. 2.6a):

- Real accelerograms
- Mandatory for buildings >40m height
- Spatial modeling



**Figure 1.** General seismic zoning map of the Republic of Uzbekistan (T.U. Artikov, R.S. Ibragimov et al.)



**Table 2. Structural Measures (Section 3 Analysis) - Limit Parameters by Building Types**

No.	Load-bearing structures	7 int.	9* int.	Diff.
1	Single-story metal frames	THCP	7.5(1)	-
2	Single-story RC frames	THCP	7.5(1)	-
3	RC with braces or frame-braced	56(16)	12(3)	44(13)
4	RC rigid reinforced frames	42(12)	8(2)	34(10)
5	Transverse walls spacing $\leq 4.2\text{m}$	THCP	12(3)	-
6	Transverse walls $>4.2\text{m} \leq 6.6\text{m}$	80(20)	9(2)	71(18)
7	Transverse walls $>6.6\text{m}$	39(9)	5(1)	34(8)
8	Hand-laid complex walls: Class I	30(7)	7(2)	23(5)
9	Hand-laid complex walls: Class II	26(6)	5(1)	21(5)
10	Timber frame walls	8(2)	5(1)	3(1)

THCP - design according to requirements that are not for seismic regions

**Critical requirement:** Construction is not permitted in 9\* intensity + Soil category III zones (p. 1.8).

**Table 3. Anti-seismic Belts (Seismic Bands)**

Parameter	7 int.	8 int.	9 int.	>9/9* int.	Standard
Long. reinforcement	4Ø10	4Ø10	4Ø12	4Ø14	p. 3.5.11
Belt height	150mm	150mm	150mm	150mm	p. 3.5.11
Concrete class	B12.5	B12.5	B12.5	B12.5	p. 3.5.11
Reinforcement kg/m	~2.5 kg	~2.5 kg	~3.6 kg	~4.9 kg	calc.
Cost difference	1.0x	1.0x	1.44x	1.96x	relative

**Table 4. Column Reinforcement**

Parameter	7 int.	8 int.	9 int.	>9/9* int.
Min. reinforcement %	0.8%	0.8%	1.2%	1.2%
Max. reinforcement %	4.0%	4.0%	4.0%	4.0%



Example: 400x400mm				
- Reinforcement area (cm <sup>2</sup> )	12.8	12.8	19.2	19.2
- Number of bars	8Ø14	8Ø14	8Ø18	8Ø18
Min. column section (9 int.)	-	-	50x50cm	50x50cm

## CONCLUSION

Within the scope of this data, the structural and calculation requirements of the QMQ 2.01.03-19 "Construction in Seismic Regions" standard in effect in the Republic of Uzbekistan for various seismic zones were thoroughly analyzed. The research results are as follows.

**Height limitations:** It was determined that the maximum permitted height for monolithic reinforced concrete frame buildings is 56 meters (16 stories) in 7 intensity zones, 33 meters (9 stories) in 9 intensity zones, and only 12 meters (3 stories) in 9\* intensity zones. This data demonstrates the objective limitations of multi-story building construction in high seismic zones.

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