

**Question 1: What should be the depth of an elevator car with a 630 kg rated load, if the car width is 1100 mm, to ensure the transportation of a patient on a stretcher?**

### **Ground Truth**

**Answer:** The car depth must be 2100 mm.

### **Justification:**

- According to SP 59.13330.2020 (clause 6.2.15) and GOST 34305-2017, for the transportation of a patient on a stretcher, the car must have dimensions of 1100x2100 mm or 2100x1100 mm. With a fixed width of 1100 mm, the depth will be 2100 mm.
- The area of such a car ( $\sim 2.3 \text{ m}^2$ ) exceeds the standard for a 630 kg rated load (1.66  $\text{m}^2$  according to Table 6 of GOST 33984.1-2023).
- This solution is permissible based on clause 5.4.2.1 of GOST 33984.1-2023.

**Technical Requirement:** According to clause 5.4.2.1 of GOST 33984.1-2023, the lift must be equipped with an overload control device, and its structural components (car frame, guide rails, safety gear, brake) must be designed for a load corresponding to the actual floor area (i.e., as for a lift with a 1000 kg rated load).

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### **Model A**

#### **Briefly, from an engineering perspective:**

👉 The minimum car depth must be 2100 mm.

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### **Regulatory Justification**

A direct requirement is contained in SP 59.13330.2020 "Accessibility of Buildings and Structures for People with Limited Mobility."

#### **SP 59.13330.2020, clause 6.2.10**

The dimensions of a lift car intended for transporting a person on a stretcher accompanied by medical personnel shall be no less than:

- width — 1100 mm,
  - depth — 2100 mm.
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### **Application to Your Case**

You have specified:

- Rated load: 630 kg (a typical hospital / universal category)

- Car width: 1100 mm

**Therefore:**

- The width already meets the standard.
- The depth **must** be  $\geq 2100$  mm.

**If made smaller:**

- A stretcher ( $\approx 1900$  mm) + an attendant will not physically fit.
  - The expert review will immediately issue a non-compliance finding based on SP 59.
  - The facility will automatically fail to meet accessibility requirements.
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**Conclusion as a Chief Project Engineer**

**Minimum car depth: 2100 mm.**

Anything less is not permissible, even if the lift is "formally 630 kg" and even if the client asks to "squeeze it."

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**Model B**

As the Chief Project Engineer, having analyzed the provided regulatory framework, I offer a direct solution to your task.

**DIRECT ANSWER:**

The car depth must be **2100 mm**.

A width of 1100 mm and a depth of 2100 mm ensure compliance with the regulatory requirement for transporting a patient on a stretcher, which is mandatory for certain types of residential and public buildings.

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**ENGINEERING JUSTIFICATION (Analysis of Nuances):**

**1. Dimensional Requirement for Stretchers (Functional Priority)**

According to **SP 54.13330.2016 (clause 4.8)** and **SP 59.13330.2020 (clause 6.2.15)**, to enable the transportation of a person on a medical stretcher, the car of at least one lift in the building must have one linear dimension (depth or width) of no less than **2100 mm**.

- Since your condition already specifies the width as 1100 mm, the only option to accommodate a stretcher is to increase the depth to **2100 mm**.

**2. Resolving the "Area vs. Rated Load" Conflict**

This presents a classic technical challenge:

- According to **GOST R 53780-2010 (Table 6)**, for a lift with a **630 kg** rated load, the maximum usable car area must be **1.66 m<sup>2</sup>**.
- However, a car with dimensions of **1100 × 2100 mm** has an area of **2.31 m<sup>2</sup>**, which, according to the same table, corresponds to a rated load of **1000 kg**.

### **How to make it "permissible" (Chief Project Engineer's Logic):**

Despite the tabular limitations in GOST R 53780, this configuration (630 kg with 1100x2100 mm dimensions) is a **legitimate exception**, confirmed by other standards:

1. **GOST 34305-2017 (clause 5.3.1, Note)** explicitly mentions the existence of lifts with a "rated load of **630 kg** with car dimensions of **1100 × 2100 mm**." This proves that such a model is permissible for series production and certified.
2. **GOST R 52941-2008 (clause 5.3)** directly mandates: if a single lift is installed in a residential building, its rated load must be at least 630 kg, and its dimensions must be **1100 × 2100 mm**.

### **3. Technical Implementation:**

To prevent the Rostekhnadzor inspector or expert review from raising claims about "excessive area" for a 630 kg load:

- The lift must be equipped with an **overload control device**, strictly set to 630 kg.
- The lift's data plate and in-car signage must clearly state a nominal rated load of 630 kg, despite the visually larger area.

### **PROJECT SUMMARY:**

For transporting a patient on a stretcher in a 630 kg lift with a 1100 mm width:

1. Set the depth to **2100 mm**.
2. Ensure the door opening width is at least **800 mm** (900 mm is recommended for unobstructed stretcher access).
3. This solution is fully compliant with **SP 54.13330.2016** and **SP 59.13330.2020**, which take precedence in designing residential and public environments.

### **Model C**

To ensure the transportation of a patient on a stretcher in a 630 kg rated load lift with a car width of 1100 mm, its depth must be 2100 mm (or 2.1 m).

This is confirmed by the following data from the provided documents:

- **GOST R 52941-2008 (#1):** Specifies car dimensions (width × depth) as 1100 × 2100 mm for lifts with a rated load of 630–1000 kg.

- **SP 44.13330.2011 (#3):** States that one of the lifts must have a car depth of at least 2.1 m with a width of at least 1.1 m.
- **SP 376.1325800.2017 (#4):** Specifies that the car must have a depth (or width, depending on the layout) of 2100 mm to accommodate a person on a medical stretcher.
- **SP 59.13330.2020 (#5):** Recommends car dimensions of 1100 × 2100 mm (width × depth) for 630 kg lifts.

Thus, if the width is fixed at 1100 mm, the required depth to accommodate a stretcher is 2100 mm.

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## Model D

As the Chief Project Engineer, after analyzing your request and the provided regulatory documentation, I offer the following conclusion.

**Verdict: 2100 mm.**

### Answer:

To ensure the transportation of a patient on a stretcher with a car width of 1100 mm, the car depth must be at least 2100 mm.

In this case, since the area of such a car ( $1.1 \times 2.1 = 2.31 \text{ m}^2$ ) exceeds the standard for a 630 kg rated load ( $1.66 \text{ m}^2$ ), the lift design must include special measures to prevent overload, in accordance with the requirements for lifts with an increased car area.

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### Justification (with references to the provided documents):

#### 1. Dimensional Requirements for Stretcher Transportation:

According to **GOST 34305-2017 "Passenger lifts. Lifts for firefighters"** (which establishes geometric parameters for evacuation and rescue, also applicable to transporting patients on stretchers), clause 5.2.2 states:

*"Lifts for firefighters in which the transportation of rescued persons on stretchers is foreseen must have sufficient car dimensions for this purpose, but not less than 1100 x 2100 or 2100 x 1100 mm..."*

(See scan of page 11 of the provided PDF, clause 5.2.2).

The standard depth of a 630 kg lift car according to GOST 5746 is 1400 mm, which is physically insufficient to accommodate a standard medical stretcher (with a length of about 2000 mm).

#### 2. Requirements for the Area-to-Rated-Load Ratio:

Since a 1100×2100 mm car has an area of  $2.31 \text{ m}^2$ , while the standard maximum area for 630 kg is  $1.66 \text{ m}^2$  (according to Table 6 of GOST 33984.1-2023), it is necessary to comply

with the conditions of clause 5.4.2.1 of the same standard:

*"For an electric passenger lift... exceeding the maximum available car area is permitted... upon fulfillment of the following additional conditions:*

- a) *when there is a load in the car with a mass equal to 125% of the rated load... the car should not descend...;*
- b) *the car floor, car frame, suspension... guide rails, brake... must be designed for loads based on the condition of placing a load in the car... whose mass is equal to the rated load determined by the usable floor area of the car [i.e., as for a lift with a rated load of ~1000 kg]."*

(See scan of page 39 of the provided GOST 33984.1-2023 file, clause 5.4.2.1).

**Summary:** You can order a 630 kg rated load lift with a 2100 mm depth for stretcher transport, but the manufacturer is obligated to equip it with a car frame and safety gear rated for the actual area (as for a 1000 kg lift) to eliminate risks during overloading.

**Question 2: In a residential building 28 meters high, the client requests the removal of one of two elevators to save money. There are 6 apartments per floor. Is it permissible to leave only one elevator?**

**Correct Answer (Ground Truth):**

Leaving one elevator in a building 28 meters high is possible only if three conditions are met simultaneously:

1. **The number of floors is no more than 9.** (If a height of 28 meters results in 10 floors, then according to SP 54.13330 Appendix B, a minimum of 2 elevators is required).
2. **The total area of apartments on the floor is no more than 600 m<sup>2</sup>.**
3. **The single elevator must have a car with a depth or width of 2100 mm** (a requirement for stretcher transportation per clause 4.8 of SP 54.13330).

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## Model A

**VERDICT:**

Leaving one elevator **IS PERMISSIBLE**, but only on the condition that the building has no more than 9 floors.

If at a height of 28 meters you design 10 floors (e.g., with a floor height of 2.8 m), installing a single elevator would be a gross violation of the codes, and the expert review will not approve such a project.

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## **JUSTIFICATION:**

The answer is based on SP 54.13330.2016 "Residential Apartment Buildings" (provided by you in the documents).

### **1. The number of elevators depends on the number of floors, not just the height in meters.**

According to Appendix B (mandatory), Table B.1 (page 28 of the provided PDF):

- For buildings with "Up to 9" floors:
  - Minimum number of elevators: 1.
  - Rated load: 630 or 1000 kg.
- For buildings with "10 - 12" floors:
  - Minimum number of elevators: 2 (one 400 kg, the second 630 or 1000 kg).

### **2. Limitation on the area per floor.**

Table B.1 is applicable provided that the total area of apartments on the floor does not exceed 600 m<sup>2</sup>.

- You have 6 apartments per floor. If their average area does not exceed 100 m<sup>2</sup> ( $6 * 100 = 600$ ), you comply with the standard for one elevator (on the condition of 9 floors).

### **3. Requirements for the single elevator.**

If you leave one elevator, it must comply with clause 4.8 of SP 54.13330.2016 (page 6 of the PDF):

- The car must have a depth or width of 2100 mm (for transporting a person on a medical stretcher).
- The door opening width must allow for the passage of a wheelchair.
- The rated load must be at least 630 kg (according to Table B.1).

### **Summary for the client:**

If you are designing a 9-story building (height ~27-28 meters), one elevator with a 630-1000 kg rated load and a deep car is sufficient. If you are trying to "fit" a 10th floor within the 28-meter height — two elevators are mandatory.

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## **Model B**

Based on the provided data (primarily SP 54.13330.2016), the answer is **no, one elevator cannot be removed.**

Here is the justification:

- **Number of Floors and Elevators:**

According to the table in SP 54.13330.2016 (#5), the number of elevators depends on the number of floors:

- Up to 9 floors, 1 elevator is permitted (with a rated load of 630 or 1000 kg).
- For 10–12 floors, 2 elevators are already required.

With a building height of 28 meters and a standard floor height of 2.8 m (which is explicitly stated in Note 2 to the table in source #5), the building has 10 floors ( $28 / 2.8 = 10$ ). Consequently, according to the codes, a minimum of two elevators is necessary.

- **Evacuation and Fire Safety Requirements:**

A height of 28 meters is a critical threshold in Russian design (the boundary between types of stairwells and fire safety requirements).

- SP 267.1325800.2016 (#4) indicates that for fire department access to the high-rise part of the building (often considered the area above 28 m), at least two elevators with a "transport of fire brigades" mode must be provided.

- **Transportation of Patients:**

As noted in Note 1 of source #5, at least one of the elevators in residential buildings must have dimensions of 2100×1100 mm (for stretchers). If the building has 10 or more floors, the presence of a second (backup) elevator becomes mandatory to ensure uninterrupted operation and accessibility of housing.

**Conclusion:** Since a height of 28 meters corresponds to a 10-story building, the requirements of SP 54.13330.2016 mandate the installation of at least 2 elevators. Saving money in this case would violate fire safety codes and the rules for designing residential buildings.

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## Model C

### Brief and strict, as a Chief Project Engineer:

 **NOT PERMISSIBLE.** You cannot leave one elevator.

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### Justification Based on Current Russian Federation Codes

#### **1 Building Height → Mandatory Elevators**

SP 54.13330.2022 "Residential Apartment Buildings," clause 6.5.6:

In residential buildings taller than 5 floors (or with a height of more than 15 m), elevators must be provided.

A 28 m building — the elevator requirement is mandatory.

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## **2 Minimum Number of Elevators**

The same SP 54.13330.2022, clause 6.5.8:

In residential buildings with more than 9 floors, at least two elevators must be provided.

Height of 28 m ≈ 9–10 floors →

→ A minimum of 2 elevators is a **strict regulatory requirement**, not a recommendation.

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## **3 Evacuation and Accessibility Requirements**

SP 59.13330.2020 (Accessibility), clause 6.2.8:

In buildings with more than 3 floors, an elevator must be provided to ensure access for people with limited mobility.

 With a single elevator:

- There is no redundancy.
  - In case of an accident or fire, accessibility for people with limited mobility is not guaranteed.
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## **4 Operational Reliability**

GOST 33984.1–2016 / TR CU 011/2011 "Safety of lifts":

- Elevators are high-hazard equipment.
- Redundancy is mandatory in high-rise residential buildings.

One elevator =

-  Service interruption during repairs
  -  Violation of accessibility requirements
  -  Socially unacceptable operation
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### **What does NOT serve as a basis for reducing the number of elevators**

-  Number of apartments per floor (6 units)
-  Client's savings
-  "Low occupancy"
-  Private ownership

The codes depend on height, not on the density of apartments.

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### **Final Decision of the Chief Project Engineer**

 Leaving one elevator is **NOT PERMISSIBLE**.

Minimum — 2 elevators, regardless of the number of apartments per floor.

If the client insists:

- A written refusal of the design solution is recorded.
  - The Chief Project Engineer has no right to issue project/working documentation with a single elevator.
  - The expert review is guaranteed to give a negative conclusion.
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## Model D

As the Chief Project Engineer, I have analyzed your request and the provided regulatory framework. The decision to reduce the number of elevators to one in a 28-meter-high building is borderline, but **a legal way to implement this exists** if three critical conditions are met.

### Expert Opinion:

According to **SP 54.13330.2016 (clause 4.8)**, the minimum number of elevators is determined by **Appendix B**. For residential buildings up to 9 stories inclusive (which roughly corresponds to your 28 meters) with a total apartment area per floor of up to 600 m<sup>2</sup>, **the installation of a single elevator is permitted**.

However, to remove the second elevator and pass the expert review, you must meet the following requirements:

#### 1. Car Dimensions (The "Stretcher" Requirement)

According to **clause 4.8 of SP 54.13330.2016**, if there is only one elevator in the section, its car **must** have dimensions (width or depth) of at least **2100 mm**.

- **Why:** This is necessary for the unimpeded transportation of a person on a medical stretcher.
- **Risk:** A standard passenger elevator (400 kg rated load) will not suffice. You will have to specify a lift with a rated load of 630 kg or 1000 kg with an elongated car.

#### 2. Checking the "Threshold Height" (28 meters)

The figure of 28 meters appears in your question. In design, this is a "watershed":

- If 28 meters is the **building height** (from the fire engine access level to the windowsill of the top floor), then the building belongs to class F1.3 with specific requirements.
- However, if the **floor level of the top residential story** exceeds the level of the first floor by more than **28 meters**, then according to Appendix B of SP 54.13330, the number of elevators automatically increases to **two** (regardless of the floor area).
- **Action:** Check the architectural section drawing. If the floor level of the top floor is +27.900 — one elevator is possible. If it is +28.100 — you are obligated to install two.

### **3. Traffic Capacity Calculation**

Although you have only 6 apartments per floor, **GOST R 52941-2008** and **GOST 34758-2021** require ensuring a "standard level of service."

- With 6 apartments per floor and a height of 9 floors (54 apartments in total), one 630/1000 kg rated load elevator usually handles the waiting interval. However, if the apartments have many rooms (high occupancy), the calculation may show that the waiting time is exceeded, and the expert review will require a second elevator based on "living comfort."
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#### **Final Verdict of the Chief Project Engineer:**

#### **Leaving one elevator IS PERMISSIBLE if:**

- The **floor level** of the top residential story is not higher than **28.0 meters** from the building entrance level.
- The single elevator has a car with an internal dimension of **2100 mm** on one of its sides (for stretchers).
- The total area of apartments on the floor does not exceed **600 m<sup>2</sup>** (with 6 apartments, this is most likely met).

#### **How to save money correctly:**

Instead of two small elevators (400 kg + 400 kg), install **one large one (1000 kg)** with a stretcher transport mode. This will allow you to save on the cost of equipment, installation, and the area of the lift shaft without violating the requirements of **SP 54.13330.2016**.

**Attention:** If the building were taller than 50 meters, the requirement of **clause 7.4.6 of SP 54.13330** for a lift for fire brigades would become a blocking factor, but in your case (28 m), it does not apply.

#### **Question 3: Is it permissible to design a habitable room without natural lighting if enhanced artificial lighting and supply ventilation are provided?**

#### **Correct Answer (Ground Truth):**

No, designing a "habitable room" specifically without natural lighting is prohibited, regardless of the power of the lamps or the presence of ventilation.

#### **Justification:**

- SP 54.13330.2016, clause 9.12:** A direct requirement for the presence of natural light in habitable rooms and kitchens.

2. **SP 54.13330.2016, clause 9.14:** Habitable rooms are not included in the list of spaces where the absence of windows is permitted (unlike bathrooms, corridors, and storage rooms).
  3. **Regulatory Logic:** A habitable space must comply with the standards for the Daylight Factor (DF). Artificial lighting is only a supplement to natural light, not a replacement for it.
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## Model A

Based on building codes and regulations (specifically, SP 52.13330.2016), the answer is **no, it is not permissible**.

### Justification:

- **Mandatory Natural Lighting:** According to SP 52.13330.2016 (#3), "spaces with permanent human occupancy must have natural lighting." Habitable rooms (bedrooms, living rooms) fall precisely into the category of spaces with permanent occupancy.
- **Exceptions:** It is only permitted to design spaces without natural lighting if they are intended for temporary human occupancy (e.g., storage rooms, bathrooms, corridors) or specific types of premises explicitly mentioned in other codes of practice (e.g., in basement levels, if permitted for specific functions).
- **Insufficient Compensation:** Enhanced artificial lighting and supply ventilation are not a legal basis for omitting natural lighting in habitable rooms. Natural light is necessary not only for visibility but also for meeting human biological needs (insolation), which is established in sanitary norms.

**Conclusion:** A project for a habitable room without a window will not pass the expert review, as it violates the requirement for mandatory natural lighting for places of permanent residence.

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## Model B

Based on the provided regulatory documents, the answer to your question is: **NO, designing a habitable room without natural lighting in a multi-apartment residential building is PROHIBITED.**

The use of enhanced artificial lighting and supply ventilation is not a legal basis for excluding window openings in habitable spaces.

### Technical-Legal Justification:

1. **Direct Requirement for Natural Light:**

- **SP 54.13330.2016 "Residential Apartment Buildings" (§ 9.12):** Establishes an imperative norm: "Habitable rooms and kitchens (except for kitchenettes) must have natural lighting."
- **SP 376.1325800.2017 (§ 8.6):** Duplicates this requirement for residential buildings and dormitories: "Habitable rooms and kitchens must have natural lighting."

## 2. Requirements for Structural Solutions:

- **SP 267.1325800.2016 (§ 12.2.3):** Habitable rooms in apartments must be provided with natural lighting exclusively "through light openings in the external enclosing structures of the building."
- **SP 55.13330.2016 (§ 9.18):** Defines the minimum limit for insolation and lighting. The ratio of the area of light openings to the floor area of habitable rooms must be at least 1:8.

## 3. Standardized Indicators (Daylight Factor - DF):

- **SP 52.13330.2016 (§ 5.8):** The calculated value of the Daylight Factor (DF),

$$e_p$$

, must not be less than the standardized value

$$e_n$$

. According to SP 267.1325800.2016 (§ 12.2.3), the DF value for habitable rooms must be at least 0.5%. Designing a room without windows makes it physically impossible to meet this condition (

$$e_p = 0$$

).

## 4. Status of Artificial Lighting:

- **SP 376.1325800.2017 (§ 8.7):** Artificial lighting is supplementary (general and local), not a replacement.
- **SP 367.1325800.2017 (§ 7.2.4):** Increasing artificial lighting standards by one level is permitted only for combined lighting, where natural light is present, but its calculated value (DF) is less than 80% of the norm. The complete absence of natural light in habitable rooms is not permitted by this standard.

### **Conclusion:**

The regulatory framework (SP 54.13330, SP 52.13330, SP 376.1325800) classifies the presence of natural lighting in habitable rooms as a mandatory sanitary-epidemiological requirement. Artificial lighting and ventilation do not replace insolation and natural light in spaces intended for permanent residence.

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## **Model C**

**Verdict: NOT PERMISSIBLE.**

As a Chief Project Engineer, I cannot approve such a design solution for a habitable room. The presence of enhanced artificial lighting and supply ventilation does not negate the mandatory requirement to provide natural lighting in spaces with permanent human occupancy.

**Justification from the provided documents:**

1. **SP 376.1325800.2017 "Residential Buildings and Premises for Temporary Residence":**
  - **Clause 8.6:** "Habitable rooms and kitchens, as well as public-use premises integrated into temporary residence buildings, must have natural lighting..."
  - **Clause 8.9:** Contains an exhaustive list of premises that may be designed without natural lighting (laundry rooms, storage rooms, bathrooms, corridors, halls, etc.). Habitable rooms are not on this list.
2. **SP 257.1325800.2020 "Hotel Buildings":**
  - **Clause 5.15:** The design of habitable rooms in hotel units is based on calculations of insolation and natural lighting in accordance with SanPiN 1.2.3685-21 (formerly SanPiN 2.2.1/2.1.1.1076 and SanPiN 2.2.1/2.1.1.1278). This implies the mandatory presence of light openings.
3. **SanPiN 1.2.3685-21 "Hygienic Standards..." (the foundational document for all residential premises):**
  - Establishes mandatory standards for the Daylight Factor (DF) for habitable rooms. Replacing natural light with artificial light in habitable rooms is not permitted by the sanitary norms of the Russian Federation.

**Summary:** A habitable room without a window (natural light) will be classified as a storage room, dressing room, or utility space, but it cannot be operated as a habitable room.

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## **Model D**

**Brief answer from the Chief Project Engineer:**

 **NOT PERMISSIBLE.**

Enhanced artificial lighting and supply ventilation do not replace natural lighting for habitable rooms—this is directly prohibited by current regulations.

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## **Regulatory Justification**

### **1 Habitable rooms are required to have natural lighting**

**SP 54.13330.2022 "Residential Apartment Buildings," clause 5.10:**

*Habitable rooms and kitchens in apartments must have natural lighting.*

The wording is imperative.

Without windows, it is not a habitable room by the definition of the SP.

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### **2 The requirement is confirmed by sanitary norms**

**SanPiN 2.2.1/2.1.1.1278-03, clause 3.1:**

*Habitable premises must have natural lighting.*

And further:

*Premises without natural lighting are permitted only for auxiliary and utility purposes.*

A habitable room does not fall into this category.

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### **3 Daylight Factor (DF) is a mandatory parameter**

The same SanPiN + SP 52.13330 ("Natural and Artificial Lighting") require ensuring a specific Daylight Factor (DF).

If there is no window → DF = 0 → automatic non-compliance.

The regulations do not provide for any "compensation" with lamps and ventilation.

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## **What is permitted without natural light**

You can design the following without windows:

- bathrooms
- washrooms
- dressing rooms
- corridors
- storage rooms

But NOT habitable rooms.

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## **Conclusion as a Chief Project Engineer**

 Designing a habitable room without natural lighting is prohibited, even with:

- enhanced artificial lighting
- mechanical supply ventilation
- heat recovery
- "smart" systems
- the client's consent

The expert review will immediately issue a non-compliance finding based on SP 54 + SanPiN.

This is a 100% rejection-guaranteed solution.

**Question 4: Is it permissible to design a kitchen-niche without natural lighting in a one-room apartment, and what are the ventilation requirements in this case?**

**Correct Answer (Ground Truth):**

Yes, designing a kitchen-niche without natural lighting is permitted in residential apartment buildings (clause 9.12 of SP 54.13330.2016).

**Main requirements:**

- **Stove Type:** An electric stove is mandatory (clause 3.13). Gas equipment is not allowed.
  - **Minimum Area:** Not less than 5 m<sup>2</sup> (clause 5.7).
  - **Ventilation:** An exhaust hood with an airflow of at least 60 m<sup>3</sup>/h is mandatory (Table 9.1).
  - **Layout:** The kitchen-niche must be located within a part of a habitable or auxiliary room (clause 3.13).
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**Model A**

Based on the provided regulatory documents, the expert conclusion on the matter of designing a kitchen-niche in a one-room apartment is prepared as follows:

**1. Natural Lighting for a Kitchen-Niche**

**Verdict: PERMITTED.**

- **For multi-apartment residential buildings:** According to SP 54.13330.2016 § 9.12, habitable rooms and kitchens must have natural lighting. However, the text of this clause explicitly states an exception: "except for kitchen-niches." Thus, in a multi-apartment building, designing a kitchen-niche without a window (natural lighting) is allowed.
- **For single-family homes:** According to SP 55.13330.2016 § 9.18, kitchens must be provided with natural lighting, and the ratio of the window area to the floor area must be at least 1:8. No exceptions for kitchen-niches are provided in this code of practice.
- **For specialized housing (for people with limited mobility):** If the apartment is intended for residents with disabilities, according to SP 137.13330.2012 § 5.4 and SP 35-102-2001 § 3.4, kitchens must be provided with natural lighting in accordance with SanPiN and SP 52.13330, with no exceptions mentioned for niches.

## **2. Ventilation Requirements**

The provided fragments of regulatory documents do not contain specific numerical values (air exchange rates or exhaust volume in m<sup>3</sup>/h) specifically for kitchen-niches. The following general requirements for system design are established:

- **General Rules:** The design and installation of ventilation systems must be carried out in accordance with the requirements of SP 60.13330 (as per SP 31-105-2002 § 13.1.1 and GOST R 58762-2019 § 4.4.1).
- **Microclimate:** When designing ventilation systems, it is necessary to ensure optimal microclimate parameters in accordance with GOST 30494 (mentioned in SP 464.1325800.2019 § 11.2 as a general principle for engineering equipment).

### **Final Conditions for the Legality of the Solution:**

- **Building Type:** The decision to omit natural lighting in a kitchen-niche is legal only for multi-apartment residential buildings (based on SP 54.13330.2016).
- **Apartment Designation:** The apartment must not be specialized (for disabled persons/people with limited mobility), as the requirements for natural lighting in their kitchens are unconditional (SP 137.13330.2012).
- **Ventilation:** The ventilation system must be designed according to the standards of SP 60.13330. Specific exhaust parameters are not specified in the provided text, but their presence is mandatory to ensure the microclimate according to GOST 30494.

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## **Model B**

### **Briefly, as a Chief Project Engineer:**

- 👉 **YES** — a kitchen-niche without natural lighting in a one-room apartment is permitted.  
👉 **BUT** — only if strict requirements for ventilation and layout are met.

Let's break it down according to current regulations.

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### **1. Is a kitchen-niche without a window permitted?**

#### **SP 54.13330.2022 "Residential Apartment Buildings," clause 5.11**

In one-room apartments, the creation of a kitchen-niche without natural lighting is permitted, provided it is combined with a habitable room.

#### **Key conditions:**

- ✓ The apartment is specifically a one-room apartment.
- ✓ The kitchen-niche is not isolated by solid partitions.
- ✓ It is part of a common space (kitchen-living room).

If the client tries to make a "dark kitchen" as a separate room —

 this is already a violation.

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## 2. Ventilation requirements for a kitchen-niche

Here, **SP 60.13330.2020 "Heating, Ventilation, and Air Conditioning"** comes into play.

### Minimum exhaust rate

According to Table 9.1 of SP 60:

- kitchen with an electric stove — not less than 60 m<sup>3</sup>/h
- kitchen with a gas stove — not less than 90 m<sup>3</sup>/h

This requirement is fully maintained for a kitchen-niche.

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### Mandatory mechanical exhaust

Since there is no natural window:

-  the exhaust must be mechanical
-  and connected to the building's main ventilation duct or an individual duct.

Natural ventilation through a transom window is by definition impossible here.

---

### Prohibition of recirculation

#### SP 60.13330.2020, clause 6.5.7:

*Air removal from kitchens must be carried out without recirculation.*

That is:

-  A "charcoal filter hood venting into the room" does not count as ventilation.
-  A simple recirculation hood without a duct is a violation.

There must be an actual discharge of air.

---

## 3. Additional mandatory points (that are often forgotten)

### Gas

If the stove is gas-powered:

-  a kitchen-niche is forbidden altogether.

#### SP 54.13330.2022:

*Premises with gas-using equipment must be isolated and have a window.*

This means a kitchen-niche = electric stove only.

---

## Air supply

According to SP 60:

the exhaust must be compensated by an air supply from the living area:

- through transfer grilles
- or a gap under the door (if there is conditional zoning).

Without an air supply, the exhaust system is not compliant.

---

## Conclusion as a Chief Project Engineer

### Permitted:

A kitchen-niche without natural lighting in a one-room apartment is **POSSIBLE** if:

- it is combined with a habitable room
  - the stove is electric
  - there is a mechanical exhaust of  $\geq 60 \text{ m}^3/\text{h}$
  - the exhaust is connected to a ventilation duct (without recirculation)
  - an air supply is provided
- 

### Not Permitted:

- making it a separate dark room
- using a gas stove
- relying solely on a charcoal filter hood
- removing the ventilation duct

The expert review rejects such solutions immediately.

---

## Model C

**Yes, designing a kitchen-niche without natural lighting in a one-room apartment is permitted.**

Based on the provided data, the following requirements apply to such premises:

### 1. Lighting

According to SP 54.13330.2016 (#3), habitable rooms and kitchens must have natural

lighting; however, kitchen-niches are an exception to this rule. Natural lighting is not standardized for them.

## 2. Ventilation

Strict air exchange requirements are established for kitchen-niches:

- **Mechanical Induction:** The kitchen-niche must be equipped with mechanical exhaust ventilation (SP 466.1325800.2019 [#4], SP 31-107-2004 [#1]).
- **System Type:** Some sources (SP 31-107-2004 [#1]) specify that it must be provided with a mechanical supply-exhaust ventilation system.

## 3. Additional Conditions

- **Equipment:** The kitchen-niche must be equipped with an electric stove (SP 31-107-2004 [#1]). Designing kitchens without windows with gas stoves is prohibited for safety reasons.
- **Layout:** A kitchen-niche is defined as a room (or part of it) without a dining area, intended only for cooking (SP 31-107-2004 [#1]).

**Summary:** You can design a kitchen-niche without a window if you install an electric stove and provide forced (mechanical) exhaust ventilation.

---

## Model D

As a Chief Project Engineer, I have analyzed your question based on the provided document SP 54.13330.2016 "Residential Apartment Buildings" (Updated edition of SNiP 31-01-2003).

Here is my answer:

### 1. Verdict

#### **PERMISSIBLE.**

Designing a kitchen-niche without natural lighting (without a window) in a one-room apartment is permitted.

### 2. Justification (according to SP 54.13330.2016)

#### **Regarding natural lighting:**

According to clause 9.12, natural lighting is mandatory for habitable rooms and kitchens. However, this same clause contains a direct exception for kitchen-niches:  
*"Habitable rooms and kitchens (except for kitchen-niches), public-use premises... must have natural lighting."*

#### **Regarding the stove type:**

A kitchen-niche is permitted only on the condition that an electric stove is installed. The installation of gas equipment in a kitchen-niche is prohibited (as the habitable room and

kitchen are combined, and gas requires an isolated room).

**Clause 3.13 (Terms and Definitions):** "*kitchen-niche: A kitchen without a dining area, located in a part of a habitable or auxiliary room and equipped with an electric stove..."*

**Regarding the area:**

The area of the kitchen-niche zone must be at least 5 m<sup>2</sup>.

**Clause 5.7:** "*In apartments, it is permitted to design kitchens or kitchen-niches with an area of not less than 5 m<sup>2</sup>"*

### **3. Ventilation Requirements**

The ventilation requirements for a kitchen-niche are regulated by the following clauses of SP 54.13330.2016:

- **Ventilation Type:**

According to the definition in clause 3.13, a kitchen-niche must be equipped with:  
"...supply-exhaust ventilation with mechanical or natural induction."

**Chief Project Engineer's Comment:** Since there is no window in the niche itself, the air supply must be provided through the adjacent room (living room or corridor) where an air supply is organized (through windows/valves), or via a mechanical supply system. Exhaust from the niche zone is mandatory.

- **Air Exchange Standard:**

According to Table 9.1 (section 9.2 "Calculated Air Parameters"):

- The air exchange rate (in service mode) for a kitchen with an electric stove is **60 m<sup>3</sup>/h**.

**Summary for the project:**

You can place a kitchen-niche in a "dark" area of the apartment (e.g., in the back of a room or in a corridor) if you allocate a minimum of 5 m<sup>2</sup> for it, install an electric stove, and provide an exhaust duct with a flow rate of at least 60 m<sup>3</sup>/h.

**Question 5: A client asks to place the entrance group of a residential building at an elevation of -0.450 from ground level, without a ramp, using only a lifting platform. Is this sufficient to ensure accessibility for people with limited mobility (PLM)?**

**Verification with Documents (Ground Truth):**

1. **Direct prohibition of replacing a ramp with a platform at the entrance:**

- **SP 59.13330.2020, clause 6.1.2:** "In accessible entrances to a building... the difference in elevations should be minimized... In case of a height difference, entrance landings, in addition to stairs, **must have a ramp**."
- The phrase "must have a ramp" is imperative. The presence of both a staircase and a ramp is a basic requirement for an entrance.

## 2. Where a choice is possible (a trap for the models):

- **SP 59.13330.2020, clause 5.1.14:** This clause discusses paths of travel on the site (at external staircases) and allows for a choice: "...the following should be provided: ramps... lifting platforms..."
- Clients often refer to this clause, but clause 6.1.2 (which is specific to entrances) takes precedence.

## 3. Status of a lifting platform:

- **SP 59.13330.2020, clause 6.2.8:** "In case of a floor level difference within a building or structure, stairs, ramps, or lifting devices should be provided..."
- However, for the entrance group (clause 6.1.2), a ramp is mandatory. A platform can only be an additional means of enhancing comfort.

## 4. The issue of evacuation:

- Model A correctly noted that an entrance is an evacuation route. A platform cannot be considered an evacuation route because it depends on electricity and mechanics. A ramp is a static structure.

---

## Model A

As the Chief Project Engineer, I have analyzed the client's request and the regulatory documentation.

### **Verdict: NOT PERMITTED.**

Designing an entrance group for a residential building with only a lifting platform, without constructing a ramp, is a violation of the mandatory requirements of the codes for new construction.

### **Justification:**

#### 1. Direct requirement for a ramp at the entrance:

According to **SP 59.13330.2020 (clause 6.1.2)**, the wording is imperative (mandatory):

*"In accessible entrances to a building (structure), the difference in elevations between the sidewalk and the vestibule should be minimized. In case of a height difference, entrance landings, **in addition to stairs, must have a ramp.**"*

Unlike paths of travel on the site (clause 5.1.14), where a choice between a ramp and a lift is permitted, the standard for a building entrance strictly requires the presence of a ramp.

#### 2. Ensuring unhindered access and reliability:

A lifting platform is a mechanical device that requires a power supply, regular maintenance, and can fail (break down, freeze, lose power). In such a case, the

building becomes completely inaccessible to people with limited mobility, which violates Federal Law No. 384-FZ "Technical Regulation on the Safety of Buildings and Structures" (Art. 12) regarding ensuring accessibility. A ramp is a stationary architectural element that ensures accessibility at all times.

### 3. **Evacuation:**

The entrance group is, as a rule, an evacuation route. According to SP 1.13130.2020 and SP 59.13330.2020 (clause 6.2.22), a ramp can serve as an evacuation route, but a lifting platform cannot (it cannot be used during a fire).

#### **Exception (when it is theoretically possible):**

Replacing a ramp with a lifting device is permitted only during the reconstruction or major renovation of existing buildings in established urban areas ("constrained conditions"), when it is physically impossible to install a compliant ramp (note to clause 6.2.9 of SP 59.13330.2020). However, this requires rigorous justification in the project documentation and, as a rule, coordination of the design assignment with social welfare authorities or associations of disabled people.

For new construction, forgoing a ramp for a height difference of 0.45 m is unacceptable.

For a height of 0.45 m, the length of the ramp (with a slope of 1:20 / 5%) would be 9 meters, which is quite feasible in most projects.

---

## **Model B**

### **Briefly, as a Chief Project Engineer:**

#### **👉 NOT PERMITTED.**

Placing the entrance group at an elevation of -0.450 m and compensating for the difference only with a lifting platform is **not sufficient** to ensure accessibility for people with limited mobility.

A lifting platform can only be an **additional** measure, but it does not replace a mandatory accessible route (a ramp / level entry).

Let's break it down according to current regulations.

---

### **1. The main requirement: there must be a continuous accessible route**

#### **SP 59.13330.2020 "Accessibility of Buildings and Structures for People with Limited Mobility," clause 5.1.3**

*Continuous accessible routes must be provided along the paths of travel for people with limited mobility, ensuring independent access to the building.*

If the entrance is at -0.450 and there is no ramp, there is no independent route.

A platform requires:

- power supply
  - maintenance
  - often, assistance from third parties
    - This is no longer independent access.
- 

## 2. Lifting platforms are only an auxiliary solution

### SP 59.13330.2020, clause 6.2.6

*Lifting platforms may be used **in addition to** the primary means of ensuring accessibility.*

The key phrase is *in addition to*, not *instead of*.

So, the regulatory logic is:

 first — a ramp / "zero-level" entry / elevator

 then (if necessary) — a platform

But not the other way around.

---

## 3. For a 450 mm difference, a ramp is mandatory

450 mm = 45 cm.

According to SP 59:

- maximum ramp slope is 8% (1:12.5)
  - which means a ramp length of approximately 5.6 m is required.  
This is a normal, manageable height difference that must be resolved with a ramp or by grading the terrain. A platform here is considered an unjustified replacement.
- 

## 4. Residential buildings have a special requirement

### SP 54.13330.2022 "Residential Apartment Buildings," clause 6.5.1

*Entrances to residential buildings must be designed taking into account the accessibility requirements for people with limited mobility.*

In the expert review, this is interpreted unequivocally:

 The main entrance must be barrier-free or have a ramp.

A platform is only a backup.

---

## Final Decision of the Chief Project Engineer

 The option "-0.450 + only a lifting platform" is **NOT PERMITTED**.

To comply with the SP, you need to:

- either organize the entrance at ground level (0.000)
  - or provide a compliant ramp
-  The lifting platform can be kept as an additional option.

If only the platform is left:

- it's a violation of SP 59.13330.2020
  - a finding from the expert review is guaranteed
  - the facility will fail the accessibility check for people with limited mobility.
- 

### One-line summary

 **No, it is not sufficient. A lifting platform does not replace a ramp or a barrier-free entrance. At an elevation of -0.450, a ramp (or a "zero-level" entrance) is mandatory.**

---

### Model C

Based on the provided regulatory documents, the proposed solution (entrance group at an elevation of -0.450 without a ramp, only with a lifting platform) **is not sufficient** to ensure accessibility for people with limited mobility.

#### Justification:

##### 1. Violation of the principle of equal accessibility conditions

According to **SP 143.13330.2012 (clause 5.16)**, in case of height differences on paths of travel and at building entrances, it is necessary to create **equal conditions of accessibility and comfort for all categories of visitors**. The use of a mechanical lifting platform instead of a stationary ramp or a ground-level entrance makes a person with a disability dependent on the equipment's serviceability, power supply, or staff assistance, which violates the principle of equal conditions compared to other population groups.

##### 2. Requirement for path continuity

**SP 136.13330.2012 (clause 5.1)** establishes a mandatory requirement to maintain the **continuity of pedestrian paths** that provide access for disabled people to buildings. A lifting platform is an interruption of the natural pedestrian path and a technical means of overcoming an obstacle, which is permissible only when it is impossible to install a ramp or a ground-level entrance (no justification of impossibility is provided in the text).

##### 3. Priority of ground-level entry

Although **SP 460.1325800.2019 (clause 6.14)** pertains to educational organizations, it establishes a general design norm: the organization of the entrance to a building should be **from ground level**. Placing the entrance group at an elevation of -0.450 (below ground level) creates an artificial height difference that requires additional accessibility measures.

#### **4. Conditions for using lifting platforms**

According to **SP 136.13330.2012 (clause 9.3)** and **SP 537.1325800.2024 (clause 13.2)**:

- Lifting platforms must ensure conditions for unhindered and safe movement.
- When using them, the dimensions for an accompanying person must be taken into account (according to GOST R 51630).
- A platform is a measure of last resort. In the context of **SP 537.1325800.2024 (clause 13.3)**, operation must comply with the design solutions for accessibility, where mechanical means require constant maintenance to ensure "unhinderedness."

#### **Summary:**

The design solution **does not comply** with the norms regarding the provision of "equal conditions" and "path continuity." To ensure accessibility, it is necessary to either provide a ramp in addition to the stairs or change the design elevation of the entrance to provide access from ground level. A lifting platform alone, without a duplicating ramp for a 0.450 m height difference, does not provide a compliant level of accessibility.

---

#### **Model D**

Based on the provided data and current regulatory documents (primarily SP 59.13330.2020), the answer is **no, this is not sufficient**.

Here are the main reasons:

##### **1. Mandatory requirement for a ramp:**

According to **SP 59.13330.2020 (#1)**, if there is a height difference, entrance landings, in addition to stairs, **must have a ramp**. The installation of a lifting platform does not exempt from the need to design a ramp if it is technically feasible.

##### **2. Priority of passive means:**

A ramp is considered the primary means of ensuring accessibility because it does not depend on a power supply, does not require maintenance for each use, and is available to all categories of people with limited mobility (including people with strollers, for whom platforms are often inconvenient or inaccessible).

##### **3. Requirements for residential buildings:**

**SP 35-102-2001 (#3)** also directly indicates that at the entrance to a building, a ramp or curb ramp should be provided from ground level to the entrance elevation. The use of lifts instead of ramps is recommended only in exceptional cases, for example, in northern climatic regions (climatic region I) with a ventilated subfloor.

##### **4. Different needs of PLM groups:**

**SP 136.13330.2012 (#4)** notes that different means are convenient for different

groups of people: wheelchair users and people with strollers find it more convenient to use ramps, while platforms are positioned as a solution for "the frail, pregnant women, or people on crutches." Eliminating the ramp restricts the rights of a portion of citizens with limited mobility.

### **Summary:**

To ensure accessibility with a height difference of 0.45 m (which is a significant difference), you are obligated to design a ramp. A lifting platform can be installed as an additional measure, or as the sole measure only in the case of a documented technical impossibility of constructing a ramp (e.g., during reconstruction in extremely constrained site conditions), which is practically impossible to justify for the new design of a residential building.

**Question 6: The client requests to reduce the cross-section of columns in an underground parking garage from 400×400 mm to 300×300 mm to increase usable area. The building is 16 stories high, with B30 grade concrete. Is there a regulatory minimum cross-section for monolithic columns?**

### **Ground Truth**

Formally, a regulatory minimum of 300 mm exists (clause 5.2.8 of SP 430.1325800.2018), but for this specific building, such a solution is most likely unacceptable.

### **Justification:**

- **Fire Safety:** According to Table 14.1 of SP 468.1325800.2019, for columns made of heavy-weight concrete, the minimum side dimension to achieve an R150 fire resistance rating (standard for such buildings) is 400 mm. A 300 mm section only provides R120.
- **Load-Bearing Capacity:** A 16-story building creates a load that is difficult for a 300x300 mm section to support without exceeding the maximum allowable reinforcement percentage of 10% (clause 5.2.8 of SP 430).
- **Stability (Buckling):** A 300 mm section significantly increases the column's slenderness, which, given the floor height in a parking garage, can lead to a loss of stability (clause 8.1.2 of SP 63.13330.2018).

**Chief Project Engineer's Conclusion:** The client's request should be rejected as it violates fire safety (SP 468) and structural reliability codes.

---

### **Model A**

#### **Briefly, as a Chief Project Engineer:**

- 👉 There is no direct "regulatory minimum" cross-section (in mm) for monolithic reinforced concrete columns.
- 👉 However, a 300×300 mm column under a 16-story building is almost guaranteed to fail

the calculations (load-bearing capacity, stability, fire resistance, and structural requirements).

Let's break it down strictly according to the current SP (Set of Rules).

---

### **1 The SP does not have a fixed "minimum size," but it does have mandatory checks**

The main document is SP 63.13330.2018 "Concrete and Reinforced Concrete Structures."

It does not actually state: "a column must be no smaller than XX by XX."

Instead, the column must simultaneously satisfy:

- Load-bearing capacity (clauses 8.1, 8.2)
- Stability / slenderness (clause 10.3)
- Crack resistance and deformations (Section 7)
- Structural requirements for reinforcement (clauses 10.1–10.2)

If even one of these is not met, the cross-section is unacceptable.

---

### **2 The critical limitation is the column's slenderness**

#### **SP 63.13330.2018, clause 10.3.1**

Columns are calculated taking into account the loss of stability if their design slenderness exceeds the limit values.

In practice, for an underground parking garage:

- Floor height  $\approx$  3.3–3.6 m
- Effective column length  $\approx$  3.0–3.5 m

For the cross-section:

- $400 \times 400 \rightarrow$  radius of gyration  $\approx 115$  mm
- $300 \times 300 \rightarrow$  radius of gyration  $\approx 87$  mm  
Slenderness increases by approximately 1.3 times.

This sharply increases:

- second-order moments,
- eccentricities,
- required reinforcement,  
and very often pushes the column beyond acceptable limits.

---

### **3 Load-bearing capacity: B30 + 16 stories**

For a 16-story building, the load on the parking garage columns is the highest in the entire building.

Reducing the cross-section:

$$400 \times 400 \rightarrow 0.16 \text{ m}^2$$

$$300 \times 300 \rightarrow 0.09 \text{ m}^2$$

This means:

 a **44% reduction** in concrete area.

To compensate for this:

- the reinforcement percentage increases sharply,
  - problems arise with placing the bars,
  - minimum concrete cover requirements are violated.
- 

#### **4 Structural limitations on reinforcement**

##### **SP 63.13330.2018, clause 10.2.3**

Minimum distance between longitudinal bars + concrete cover + ties.

For a  $300 \times 300$  mm column with the working reinforcement needed for 16 stories, it is very often the case that:

-  there is physically no space to place the required Ø20–Ø28 bars
-  concrete cover cannot be maintained
-  the allowable reinforcement percentage is exceeded (clause 10.1.6)

That is, the column becomes structurally un-designable, even if it's formally possible to select steel "by force" calculations.

---

#### **5 Separately: Fire resistance**

For an underground parking garage, a fire resistance rating of at least R120 is typically required.

According to SP 2.13130.2020:

The fire resistance of reinforced concrete columns is mainly ensured by the thickness of the concrete cover to the reinforcement.

With a  $300 \times 300$  section:

- the concrete cover consumes a significant part of the section,
- the actual "working core" is sharply reduced.

In practice:

 a  $300 \times 300$  section under a high-rise building often fails to achieve R120 without additional fire protection.

---

#### **Conclusion as a Chief Project Engineer**

Formally:

✗ there is no "minimum size in mm" in the SP.

In reality, for your case (16 stories, parking garage columns):

👉 300×300 mm is almost certainly unacceptable due to a combination of:

- load-bearing capacity
- stability
- structural reinforcement
- fire resistance

400×400 is the typical lower limit for such buildings.

---

### Professional conclusion

If the client demands 300×300:

👉 a full calculation according to SP 63 + a check for the R rating according to SP 2 must be performed.

In 9 out of 10 cases, the result is:

✗ it fails

or

✗ it requires inadequate reinforcement + fire protection

→ the savings in area are eaten up by the increased cost.

---

### One-line summary

👉 There is no direct regulatory minimum, but for a 16-story building, a 300×300 mm column in the parking garage is almost always unacceptable by calculation. 400×400 is the engineering-justified minimum.

---

### Model B

As the Chief Project Engineer, I have analyzed your question and the provided regulatory documents.

#### Verdict:

Formally — **IT IS POSSIBLE** (the geometric standard permits 300 mm), BUT for this specific project (16 stories + underground parking), this solution is **PRACTICALLY IMPOSSIBLE** to implement in its "pure" form without special, costly measures for fire protection and reinforcement enhancement.

For a standard implementation (without special protection), the minimum cross-section will remain 400×400 mm.

---

**Justification (according to current regulations):****1. Geometric minimum (SP 430.1325800.2018):**

According to clause 5.2.8 of SP 430.1325800.2018 "Monolithic Structural Systems," a clear geometric minimum is established for monolithic columns:

*"The minimum size of a square and circular cross-section of columns should be taken as ... not less than 300 mm..."*

**Conclusion:** From a geometric point of view, reducing to 300×300 mm is permissible.

**2. Fire resistance requirements (SP 468.1325800.2019):**

Underground parking garages in multi-story residential buildings (especially 16 stories) belong to buildings of a high degree of fire resistance (usually Class I), where the required fire resistance limit for load-bearing structures (columns) is R 150 (150 minutes).

According to the SP 468.1325800.2019 provided by you, Table 14.1 ("Minimum value of the parameter, mm, of a column for a fire resistance limit, min"):

- To ensure a fire resistance limit of 120 min (R 120), the minimum column width (b) is — **300 mm**.
- To ensure a fire resistance limit of 150 min (R 150), the minimum column width (b) is — **400 mm**.

**Conclusion:** Reducing the cross-section to 300×300 mm will result in the column failing to provide the required fire safety (R 150) for a 16-story building without additional fire protection (cladding, plastering, special coatings).

**3. Load-bearing capacity (SP 63.13330.2012 / SP 430):**

For a 16-story building, the load on the columns at the underground level is colossal. B30 grade concrete in a 300×300 mm section has extremely limited load-bearing capacity. Even with maximum reinforcement (which is structurally difficult to place in a 300x300 section), such a column would most likely fail the compressive strength calculation from the load of 16 floors.

**Chief Project Engineer's Summary:**

The client should be refused the reduction of the cross-section to 300×300 mm, with reference to Table 14.1 of SP 468.1325800.2019, as the minimum side dimension of the column must be 400 mm to provide the required fire resistance (most likely R150). The savings in area would be "eaten up" by the cost of the necessary structural fire protection and ultra-high reinforcement.

---

**Model C**

Based on building codes and regulations (SP 430.1325800.2018 and SP 52-103-2007), the answer to your question is as follows:

## **1. Regulatory minimum**

Yes, a regulatory minimum exists. According to SP 430.1325800.2018 (item #1) and SP 52-103-2007 (item #2):

- For square and circular columns, the minimum cross-sectional dimension is 300 mm.
- For columns with an elongated section (pylons/blades), the minimum dimension is 200 mm.

## **2. Possibility of reducing to 300×300 mm**

Formally, a 300×300 mm section is the absolute minimum permitted by the codes.

However, for a 16-story building, this solution is associated with serious risks:

- **Slenderness:** The cross-section size must be chosen based on meeting the requirements for slenderness (SP 63.13330.2012). With a large floor height in the parking garage, 300×300 mm columns may not pass the stability (buckling) calculation.
- **Load-bearing capacity:** In a 16-story building, the load on the columns at the underground level is colossal. Even when using B30 concrete, the calculation will most likely show the need for a larger cross-section or excessive reinforcement.
- **Reinforcement percentage:** The codes limit the maximum reinforcement percentage (not more than 10% including laps, according to source #1). If more reinforcement is required to handle the load in a 300×300 mm section, such a solution would be illegal.

## **Summary**

It is possible to design 300×300 mm columns, as this is not below the regulatory threshold of 300 mm. But this will require mandatory calculation-based justification for:

- **Strength** (whether B30 and up to 10% reinforcement are sufficient).
- **Stability** (slenderness).

For the lower floors of a 16-story building, a 300×300 mm cross-section most often proves to be insufficient based on the results of strength calculations, despite being formally permitted as a minimum.

---

## **Model D (Presented as a Chief Project Technologist)**

As the chief project technologist, based on the provided regulatory framework, I present an expert opinion on the issue of reducing the cross-section of monolithic columns in the underground parking garage of a 16-story building.

### **1. Determination: Formal Admissibility of the Cross-Section**

According to GOST 25628.2-2016, a 300×300 mm section is a standard size for reinforced

concrete columns. The table in Appendix A lists standard sizes 1KB and 1KD, which have a 300×300 mm section. Thus, from the perspective of product nomenclature, a 300×300 mm section exists and is formally permitted for use in construction.

## 2. Limitation: Technological and Operational Filters

Despite the presence of the 300×300 mm section in the list of standard sizes, its application in the conditions of a 16-story building and an underground parking garage imposes strict limitations related to fire resistance and structural stiffness:

- **Fire Resistance Requirements:** According to SP 468.1325800.2019 (clause 14.5), the geometric parameters of columns made of heavy-weight concrete (B30 is a heavy-weight concrete) are strictly regulated depending on the required fire resistance limit (REI). Table 14.1 indicates that with four-sided fire exposure (typical for free-standing columns in a parking garage), the minimum column width  $b$  is:
  - For **REI 120 — 300 mm** (with a distance to the rebar axis  $a=40$  mm);
  - For **REI 150 — 400 mm** (with a distance to the rebar axis  $a=50$  mm);
  - For **REI 180 — 450 mm**.Given that for high-rise buildings (16 stories) and underground structures, the fire resistance requirement for load-bearing structures is often REI 150 or higher, a 300×300 mm section will not pass this criterion.
- **Stiffness and Support Conditions:** According to SP 356.1325800.2017 (clause 7.3.8), the dimensions of column sections must be assigned based on providing the necessary transverse stiffness and support conditions for beams. For a 16-story building, reducing the section from 400 to 300 mm critically reduces the moment of inertia of the section, which can lead to failure to meet the requirements for stability and deflection of the frame.
- **Reinforcement:** According to SP 430.1325800.2018 (clause 7.8), the diameter of longitudinal reinforcement in columns must be at least 12 mm. With a 300×300 mm section and the need to maintain the concrete cover for fire resistance (40 mm to the rebar axis per Table 14.1 of SP 468), the effective area of the concrete core is significantly reduced, which, under loads from 16 stories, may require an excessive reinforcement percentage, exceeding the permissible norms.

## 3. Conclusion (Engineering Synthesis)

Reducing the column cross-section to 300×300 mm is formally permitted by unification standards (GOST 25628.2-2016), but for a project of this category (16 stories, underground parking), it is most likely unacceptable for the following reasons:

- **Contradiction with Fire Resistance Requirements:** If the project documentation requires a fire resistance limit of **REI 150** (which is standard for such buildings), the minimum permissible cross-section according to Table 14.1 of SP

468.1325800.2019 is **400 mm**. A 300 mm section limits the fire resistance to REI 120.

- **Geometric Deviations:** According to Table 1 of GOST 25628.2-2016, the tolerance for the cross-sectional dimension is  $\pm 5$  mm for sizes from 250 to 500 mm. With a small section (300 mm), even standard deviations and errors in the thickness of the concrete cover can become critical for the load-bearing capacity of a highly loaded column.

**Final Recommendation: Reject the client's request.** A 300×300 mm cross-section will not provide the required REI 150 fire resistance and the necessary stiffness for the frame of a 16-story building. The minimum recommended cross-section is 400×400 mm.

**Question 7: In a project for a 9-story residential building, the load-bearing walls are designed using unreinforced brick masonry with a thickness of 380 mm. The construction area is located in a zone with a design seismicity of 8 points on the MSK-64 scale.**

**Is the use of such a structural solution permissible from the standpoint of the maximum number of stories and the type of load-bearing structures, according to the requirements of the SP (Set of Rules) for seismic-resistant construction? Is it necessary in this case to provide reinforcement for the masonry or other structural measures, and which regulatory provisions should be relied upon when making the decision?**

**Correct Answer (Ground Truth):**

No, it is not permissible. This is a gross violation of SP 14.13330.2018.

**Justification:**

- **Exceeding the story limit:** According to Table 6.1 of SP 14.13330.2018, the maximum height of buildings with load-bearing walls made of brick masonry in an 8-point seismic zone is 4 stories (15 m). Even for a composite structure (with reinforced concrete inclusions), the limit is 5 stories (17 m). A 9-story building project exceeds this standard by double.
- **Prohibition of unreinforced masonry:** According to clauses 6.14.11 and 6.14.13 of SP 14.13330.2018, in seismic zones of 7-9 points, the installation of anti-seismic bond beams at all floor levels and horizontal reinforcement of the masonry with mesh is mandatory. Unreinforced masonry for load-bearing walls is prohibited.
- **Recommended structural solutions:** For a 9-story building in an 8-point zone, it is necessary to completely change the structural system to a reinforced concrete frame (with infill), monolithic walls, or a large-panel system.

## **Model A**

Based on the requirements of SP 14.13330.2018 "Construction in Seismic Areas," the proposed design solution is **impermissible**.

Here is a detailed justification:

### **1. Storey and Height Limits**

According to SP 14.13330.2018 (clause 6.1.1 and Table 6.1), strict limitations are established for buildings with load-bearing walls of brick masonry in zones with 8-point seismicity:

- For brick buildings of composite construction (with reinforced concrete inclusions), the maximum number of stories at 8 points is **5 stories** (height up to 18-20 m).
- For buildings with unreinforced brick masonry, the storey limit is even more restrictive and is practically not used in multi-story construction for 8-point seismicity.
- **9 stories for a brick building in an 8-point zone is a direct violation of the codes.** For such a height (more than 27-30 meters) in seismic areas, only buildings with a reinforced concrete frame (monolithic or precast) or walls of monolithic reinforced concrete are permitted.

### **2. Requirements for the Type of Structure and Reinforcement**

According to SP 14.13330.2018 (#4, #5):

- **Unreinforced masonry is prohibited:** In zones with 8-point seismicity, load-bearing walls must be constructed as a "composite structure" at a minimum (masonry reinforced with vertical reinforced concrete cores and horizontal anti-seismic bond beams).
- **Floor height:** For unreinforced masonry at 8 points, the floor height cannot exceed 4 meters (#4).
- **Specific requirements:** The masonry must have a temporary tensile strength across unbonded joints (normal adhesion) of  $R_t \geq 1.2 \text{ kgf/cm}^2$ . This requires the use of special mortars and reinforcement.

### **3. Necessary Measures**

At 8-point seismicity for brick buildings (within the permitted height of up to 5 stories), the following are mandatory:

- **Anti-seismic bond beams:** Installed at the level of floor slabs along all walls (#5).
- **Vertical reinforcement:** Installation of reinforced concrete cores (inclusions) at corners, wall intersections, and in wall piers.
- **Horizontal reinforcement:** Mesh in the masonry joints (at least every 700 mm in height for 8 points).

## **Regulatory Provisions to rely on:**

- **SP 14.13330.2018** — the primary document. See section 6.14 "Buildings with load-bearing walls of brick or stone," Table 6.1 (storey limits), and Table 6.11 (distances between walls).
- **SP 15.13330.2020** "Stone and Reinforced Stone Structures" — regarding the general rules for designing masonry and its reinforcement.

**Conclusion:** The project for a 9-story brick residential building in an 8-point zone will not pass the expert review. It is necessary to fundamentally change the structural system to a monolithic reinforced concrete frame or shear walls.

---

## **Model B**

Having reviewed your question and the provided regulatory documents, as the Chief Project Engineer, I inform you of the following:

### **1. Verdict**

#### **Not allowed.**

The use of load-bearing walls made of unreinforced brick masonry for a 9-story residential building in an area with 8-point seismicity is strictly prohibited by current regulations.

---

### **2. Justification (with references to SP 14.13330.2018)**

The solution proposed in the project violates the requirements for the maximum number of stories and height of buildings for this structural system.

#### **A) Violation of the Storey Limit**

According to Table 6.1 (item 8) of SP 14.13330.2018 "Construction in Seismic Areas":

- For buildings with walls made of ceramic bricks and stones (unreinforced or with standard mesh reinforcement) in areas with 8-point seismicity, the following restrictions are established:
  - For masonry of the 1st category (temporary tensile strength  $R_t \geq 180$  kPa): Maximum height — **15 m (4 stories)**.
  - For masonry of the 2nd category ( $120 \leq R_t < 180$  kPa): Maximum height — **11 m (3 stories)**.

Your project assumes 9 stories, which is more than double the permissible limit.

#### **B) Even with Masonry Reinforcement (Composite Structure)**

Even if you apply maximum reinforcement (reinforced concrete inclusions, cores), classifying the walls as a "Composite Structure" (item 7 of Table 6.1), the maximum number of stories for 8 points would be **17 m (5 stories)**.

9 stories for load-bearing brick walls in an 8-point zone are not permissible under any reinforcement conditions.

---

### 3. Answers to related questions

**Question:** Is it necessary in this case to provide reinforcement for the masonry or other structural measures?

**Answer:**

- **Masonry reinforcement:** In zones with 8-point seismicity, reinforcement is mandatory even for permissible low-rise buildings (3-4 stories).
  - According to clause 6.14.11, anti-seismic bond beams must be installed at the floor levels.
  - According to clause 6.14.13, reinforcement meshes (with a total area of at least 1 cm<sup>2</sup>) must be placed at wall joints every 700 mm in height.
- **Other structural measures (Change of structural system):**

Since you want to build specifically 9 stories in an 8-point zone, the only legitimate solution is a complete change of the load-bearing structure type.  
Based on Table 6.1 of SP 14.13330.2018, for a 9-story building (approximately 28-30 m high), the following systems would be suitable:

  - **Reinforced concrete frame** (with shear walls) — permitted up to 43 m (12 stories).
  - **Monolithic reinforced concrete walls** — permitted up to 70 m (20 stories).
  - **Large-panel walls** — permitted up to 50 m (14 stories).

In these options, brick masonry with a thickness of 380 mm (or less) can only be used as non-load-bearing infill for the frame (self-supporting walls), provided the requirements of clauses 6.14.4 and 6.14.14 for their fastening and reinforcement are met.

#### **Summary for the Chief Project Engineer:**

The project in its current form cannot be submitted for expert review. It is necessary to change the structural system of the building to monolithic reinforced concrete (wall or frame system), leaving brick only for the enclosing structures.

---

### **Model C**

Based on the presented regulatory provisions, the following expert conclusion has been formed regarding your question:

#### **1. Admissibility of the Structural Solution (Storeys and Masonry Type)**

The solution is **NOT PERMISSIBLE**.

- **Justification by number of stories:** According to SP 452.1325800.2019 (§ 5.1), the requirements for the number of stories of residential buildings during construction in seismic areas are established exclusively by SP 14.13330. A similar requirement is contained in SP 546.1325800.2025 (§ 10.1.5). For an 8-point seismicity zone, strict limits on the maximum height and number of stories are established for buildings with load-bearing stone walls, which are significantly lower than 9 stories (as a rule, no more than 4–5 stories depending on the masonry category).
- **Justification by type of construction:** The use of unreinforced brick masonry for the load-bearing walls of a 9-story building in an 8-point zone contradicts safety requirements. In SP 442.1325800.2019 (Table of seismic resistance classes), it is indicated that brick buildings in seismic areas of 7 and 8 points must be designed with mandatory anti-seismic measures (Classes C6, C7). Unreinforced masonry is not one of these measures.

## 2. Necessity of Reinforcement and Other Measures

Reinforcement and additional measures are **MANDATORY**.

According to the text of the codes, to ensure seismic resistance, it is necessary to:

- **Reinforce the masonry:** SP 15.13330.2020 (§ 6.24) and SP 427.1325800.2018 (§ 6.2) provide calculated characteristics (modulus of elasticity

$$E_0$$

) separately for unreinforced and reinforced masonry. For seismic areas, the structural design must be carried out taking into account increased deformation characteristics, which requires a transition to reinforced masonry structures.

- **Mesh reinforcement:** SP 339.1325800.2017 (§ 6.2.7) points to the need for confinement (mesh) reinforcement to increase the compressive strength of the masonry and ensure its integrity under dynamic loads.
- **Anti-seismic bond beams and inclusions:** Based on SP 14.13330 (referenced by SP 522.1325800.2023 § 12.1 and SP 452.1325800.2019 § 5.1), in buildings taller than 3 stories at 8 points, anti-seismic bond beams at floor levels are mandatory, and in some cases, the installation of reinforced concrete inclusions (composite structures).

## 3. Regulatory Provisions for Decision Making

When designing and justifying the solution, it is necessary to rely on the following clauses:

- **SP 14.13330.2018** (via reference in SP 452.1325800.2019 § 5.1) — regarding storey limits and mandatory structural requirements for seismic zones.
- **SP 15.13330.2020 § 6.24** — regarding the design characteristics of reinforced masonry.

- **SP 442.1325800.2019 (Table 4.2)** — regarding the classification of buildings with anti-seismic measures for a design seismicity of 8 points.
- **SP 546.1325800.2025 § 10.1.5** — confirms the mandatory compliance of external walls with seismic resistance requirements according to SP 14.13330.

**CONCLUSION:** The project for a 9-story building with load-bearing walls of unreinforced 380 mm masonry in an 8-point zone violates the requirements for storey limits and seismic safety. A complete redesign of the structural system is required (e.g., switching to a monolithic frame or significantly reducing the number of stories while introducing comprehensive reinforcement).

---

## Model D

I am answering as a Chief Project Engineer — strictly according to the current SP.

**Briefly:**



A 9-story residential building in an 8-point zone cannot be constructed with load-bearing walls of unreinforced 380 mm brick masonry.

Simple "masonry reinforcement" will not save the situation — a different structural system for the building is required.

Let's break it down by the codes.

---

### 1. Storey limit for stone buildings at 8 points

The main document:

#### **SP 14.13330.2018 "Construction in Seismic Areas"**

We look at Table 7.1 (maximum number of stories for buildings depending on the structural system and seismicity).

For 8-point zones, it is established:

- ◆ Buildings with load-bearing walls of **UNREINFORCED** stone masonry
  - are permitted up to a maximum of **3 stories**
- ◆ Buildings with load-bearing walls of **REINFORCED** masonry
  - are permitted up to a maximum of **5 stories**

You have:

- 9 stories
- unreinforced brick masonry
  - **Exceeds the norm by 3 times.**

### **Conclusion based on SP 14:**

 Such a structural solution is prohibited by regulation, regardless of the wall thickness (380 mm doesn't matter).

---

### **2. Will reinforcing the masonry help?**

**No.**

Even if you provide for reinforced masonry:

- the maximum at 8 points is **5 stories**.  
And you have 9.

This means:

 **Reinforcing the masonry does NOT make the solution permissible.**

This is fundamentally important: the limitation here is not based on "strength," but on the **type of structural system** of the building.

---

### **3. What systems are generally permitted for 9 stories at 8 points?**

According to the same SP 14.13330.2018 (Table 7.1 and sections 6–8), for such a number of stories and seismicity, the following are applicable:

- Monolithic or precast-monolithic RC frame
- Frame-wall system (RC frame + diaphragms/stiffness cores)
- Monolithic reinforced concrete load-bearing walls
- Large-panel RC systems of factory production

Brick is only permitted as infill, not as the primary load-bearing system.

---

### **4. What is mandatory if brick is used as infill?**

If brick remains in the project (no longer as load-bearing):

SP 14.13330.2018, section 8 requires:

- anti-seismic bond beams at all floor levels
- vertical RC elements (cores, pylons)
- anchoring of the masonry to the RC frame
- calculation for a special load combination (seismic)
- expansion joints

But I emphasize:

 this is then a reinforced concrete building with brick infill, not a brick building.

---

### Final Decision of the Chief Project Engineer

✗ Load-bearing walls of unreinforced 380 mm brick masonry

✗ 9 stories

✗ 8-point seismicity

— is **categorically impermissible** according to SP 14.13330.2018.

Reinforcing the masonry does not solve the problem.

---

### What is required by the codes

👉 Change the structural system to a reinforced concrete one (frame / frame-wall / monolithic walls), and use brick only as an enclosure.

The expert review will not even consider such a brick solution — it is a direct tabular violation of the SP.

---

### One-line summary

**Not allowed:** at 8 points, unreinforced brick masonry is permitted up to a maximum of 3 stories, reinforced — up to 5. For 9 stories, a reinforced concrete load-bearing system is mandatory.

**Question 8: We are designing a monolithic slab with a span of 8.5 meters. The client has requested to omit intermediate beams, with a slab thickness of 200 mm. Is this feasible, or are there regulatory limits on deflections?**

#### Correct Answer (Ground Truth):

Designing a flat monolithic slab with a thickness of 200 mm over an 8.5 m span without intermediate beams (supports) using conventional (non-prestressed) reinforced concrete is **unfeasible and impermissible** according to code recommendations.

Such a solution:

- Violates recommendations for the minimum section depth (stiffness).
- Is guaranteed to fail the calculation for the second group of limit states (deflections and vibrations), as the actual stiffness of the section is too low for such a span.

#### Recommended solution according to codes:

- Increase the slab thickness (to approximately 280–300 mm).
- Use prestressed reinforcement (tendons).
- Introduce beams or column capitals.

---

## **Verification with Documents (Ground Truth Facts)**

This section lists only the points that actually exist in the text of the documents and are applicable to the question. Any deviation from these points in the models' answers (references to non-existent tables or incorrect interpretation of clauses) is considered a hallucination.

### **A. SP 430.1325800.2018 "Monolithic Structural Systems"**

This document is key to the answer, as the question concerns the design of monolithic structures.

- **Fact #1 (Slab Thickness):**

- Clause 5.2.14: "As a first approximation, the thickness of flat floor slabs... is recommended to be assigned no less than **L/30**... [for frame systems] and no less than **L/35** [for wall systems]."
- Calculation: For a span of 8.5 m (8500 mm), the minimum recommended thickness is:  $8500/30 \approx \mathbf{283 \text{ mm}}$ .
- Conclusion: 200 mm is critically insufficient.

- **Fact #2 (Span Limitation):**

- Clause 5.2.12: "For spans up to 6–8 m, floor slabs are predominantly designed as flat... For spans exceeding 7 m, high-strength prestressing reinforcement should be used..."
- Conclusion: For a span of 8.5 m, conventional reinforcement is not recommended; prestressing is required.

### **B. SP 20.13330.2016 "Loads and Actions"**

This document regulates the limit deflections.

- **Fact #3 (Limit Deflection):**

- Appendix D, Table D.1 (item 2.a): For floor slabs in residential/public buildings, the limit deflection depends on the span:
  - For a 6 m span — **L/200**.
  - For a 12-24 m span — **L/250**.
- Interpolation: For 8.5 m, the value will be between L/200 and L/250 (around L/212, i.e., ~40 mm). Model answers that claim a strict limit of only L/250 (like Model C) without considering the span length are inaccurate.

### **C. SP 63.13330.2018 "Concrete and Reinforced Concrete Structures"**

The basic document for calculation.

- **Fact #4 (Reference to Deflections):**

- Clause 8.2.20: "The values of maximum permissible deformations of elements are adopted according to SP 20.13330..."
- Important for checking hallucinations: SP 63 itself does not contain a table with limit deflections like "L/250". If a model (like Model C) says "see Table 7.1 in SP 63 for deflections" — this is a hallucination, as Table 7.1 in SP 63 is dedicated to the coefficient  $\phi$  (longitudinal buckling of compressed elements), not slab deflections.

#### **D. SP 266.1325800.2016 "Composite Steel and Concrete Structures"**

Applicable only if one assumes the slab is cast on profiled steel decking (this was not in the question, but Model A assumed it).

- **Fact #5 (Span without Supports):**

- Clause 8.1.2.1: When using profiled decking: "For spans exceeding 6.0 m, intermediate temporary supports should be provided."
- Conclusion: If this were a composite steel-concrete structure, an 8.5 m span without temporary supports during casting would be impossible.

---

### **Model A**

Based on the provided regulatory documents, specifically SP 430.1325800.2018 "Monolithic Reinforced Concrete Structures. Design Rules," I report the following:

#### **1. Direct Answer**

The design of a flat monolithic slab with a span of 8.5 meters without intermediate beams or capitals, with a slab thickness of 200 mm, **contradicts the regulatory recommendations** for the selection of structural systems.

#### **2. Regulatory Justification**

According to clause 5.2.12 of SP 430.1325800.2018:

- For spans up to 6–8 m, floor slabs are predominantly designed as flat.
- For span values **exceeding 8 m**, floor slabs should be designed as flat with capitals or as beam-and-slab systems.

Since your span (8.5 m) exceeds the established limit of 8 meters, the use of a simple flat slab (without beams and without capitals) does not comply with the requirements of this clause.

#### **3. Thickness and Stiffness Parameters**

- **Parameter Definition:** According to clause 5.2.14 of SP 430.1325800.2018, the slab thickness and concrete grade are determined by calculation depending on the load

and span length. However, the structurally prescribed system for spans over 8 m (beam-and-slab or with capitals) is specifically aimed at providing the necessary stiffness and limiting deflections.

- **Calculation Requirements:** In accordance with clause 5.2.1, load-bearing elements must be designed taking into account the requirements of SP 63.13330, which implies a mandatory check for the second group of limit states (by deflections). With a thickness-to-span ratio of 1/42.5 (200 mm to 8500 mm), it is technically difficult to meet the regulatory requirements for deflections for a flat slab without reinforcement.

#### 4. Summary

To comply with the design codes for a span of 8.5 meters, you MUST:

- Switch to a **beam-and-slab floor system**.
- Or use a **flat slab with capitals** (according to clause 5.2.12 of SP 430.1325800.2018).

**Note:** The use of codes for bridge structures (SP 453.1325800.2019) or composite steel-concrete structures (GOST R 59624-2021) is inapplicable in this case, as they regulate the design of special artificial structures, not civil buildings.

---

#### Model B

Designing a 200 mm thick monolithic slab over an 8.5-meter span without intermediate beams using conventional reinforced concrete is **practically unfeasible and will not pass a check against regulatory limits**.

Here are the main reasons and references to the codes:

##### 1. Span-to-Depth Ratio (L/h)

In engineering practice, the L/h ratio is used for the preliminary assignment of slab thickness.

- For continuous slabs in a beamless floor system, it is typically **1/30–1/35**.
- For your 8.5 m span, the recommended thickness is:  $8500/30 \approx 280 \text{ mm}$ .
- Your current ratio is:  $8500/200 = 42.5$ . This is a critically thin slab for such a span, which will have extremely low stiffness.

##### 2. Deflection Limits (SP 20.13330.2016)

According to SP 20.13330.2016 "Loads and Actions" (Appendix D, Table D.1), there are strict limit deflections:

- **Aesthetic-psychological requirements:** For an 8.5 m span, the limit deflection would be approximately L/200, i.e., about **42.5 mm**.

- **Structural requirements:** If there are partitions (brick, blocks) under the slab, the deflection must not exceed L/500 or L/1000 (depending on the partition type) to prevent them from cracking under load.
- With a thickness of 200 mm, the deflection from self-weight and live load on such a span (taking into account concrete creep and crack formation per SP 63.13330.2018) is **guaranteed to exceed these values several times over.**

### **3. Vibration Issues and Comfort**

With such a small thickness and a large span, the problem of **vibrations** (physiological discomfort when walking) will arise. The floor will vibrate, which is also regulated by SP 20.13330.

### **4. Reinforcement Consumption**

To try to "achieve" the strength of such a thin slab over 8.5 meters, an extremely high percentage of reinforcement would be required in the tension zone and possibly in the compression zone to control deflections. This would make the structure more expensive than if you simply increased the concrete thickness or added beams.

#### **Summary:**

- This is **unrealistic for a standard monolithic slab.** The slab will "sag" beyond the allowable limits.
- **Possible solutions:**
  - Increase the slab thickness to **250–300 mm.**
  - Introduce **capitals** (thickenings) in the column support zones.
  - Use **post-tensioning** (tendons in ducts) — this is the only way to keep the thickness at 200–220 mm for such a span, but it will significantly complicate and increase the cost of construction.
  - Use a **beam-and-slab system** or a **waffle slab.**

### **Model C**

**Briefly, as a Chief Project Engineer — based on the SP:**

 **No**, a "flat" 200 mm monolithic slab on an 8.5 m span without beams for a residential building **does not comply with regulations** — primarily due to deflections (and, as a rule, crack resistance).

Let's break it down according to current requirements.

### **1. Limit deflections — a direct regulatory restriction**

Main document: **SP 63.13330.2018 "Concrete and Reinforced Concrete Structures."**

### **Clause 7.4.3 + Table 7.1 of SP 63**

For floor slabs in residential buildings:

limit deflection  $f \leq L/250$

In your case:

- span  $L = 8.5 \text{ m} = 8500 \text{ mm}$

Permissible deflection:

👉  $8500 / 250 = 34 \text{ mm}$

This is the maximum, taking into account long-term deformations (concrete creep, long-term loads).

---

### **2. An engineer's rule-of-thumb check: span / depth ratio**

For the slab:

- $h = 200 \text{ mm}$
- $L/h = 8500 / 200 = 42.5$

For beamless monolithic slabs in residential construction, the practical working range is:

👉  $L/h \approx 25-30$

A value of 42.5 is in the zone of:

- excessive deflections,
- crack widths exceeding the allowable limit (clause 7.3 of SP 63),
- a "springy" floor,
- problems with partitions and finishes.

Even if you "pour in more reinforcement":

⚠️ the deflection will barely decrease, because stiffness is determined by the section depth, not the amount of steel.

---

### **3. Why reinforcement doesn't save the day**

According to SP 63, deflection is calculated based on the effective stiffness, taking into account crack formation and creep (Section 7).

On such a span with  $h = 200 \text{ mm}$ :

- the concrete cracks quickly,
- the effective modulus of elasticity drops sharply,

- the long-term deflection exceeds L/250.

This is a typical situation, and expert reviews catch such solutions immediately.

---

#### 4. What is actually used for a span of ~8.5 m

From design practice under the requirements of SP 63:

- Beam-and-slab system with a 180–200 mm slab
- Beamless slab with a thickness of **300–320 mm**
- Slab with capitals / thickenings
- Post-tensioned slab (~220–240 mm)

But:

- A flat 200 mm slab without beams over 8.5 m — **no.**
- 

#### Final Decision of the Chief Project Engineer

- There is a regulatory limit — on deflection, **L/250** (SP 63.13330.2018).
- For an 8.5 m span, a 200 mm slab without beams:
  - fails the deflection check,
  - usually fails the crack resistance check as well.

The expert review will require:

- either beams,
  - or an increase in thickness,
  - or capitals,
  - or post-tensioning,
  - or a change in the structural system.
- 

#### Model D

As a Chief Project Engineer, having reviewed your question in the context of the provided SP 430.1325800.2018 "Monolithic Structural Systems. Design Rules," I provide the following answer:

##### **Verdict: NOT PERMITTED.**

(In conventional, non-prestressed reinforced concrete, such a solution is unacceptable).

##### **Justification:**

- **Violation of the requirements for minimum slab thickness (stiffness):**

According to clause 5.2.14 of SP 430.1325800.2018, for a preliminary assessment, the thickness of flat floor slabs is recommended to be assigned:

- For frame and mixed systems: not less than  **$l/30$** .
- For wall systems: not less than  **$l/35$** .

- **Calculation:**

For a span of  $l = 8500$  mm:

- $8500 / 30 = \mathbf{283 \text{ mm}}$ .
- $8500 / 35 = \mathbf{243 \text{ mm}}$ .

The 200 mm requested by the client is significantly less than the minimum recommended values. Such a slab will not pass the mandatory deflection check (second group of limit states) required by Section 6 of this SP.

- **Limitation by structural type for large spans:**

According to clause 5.2.12 of SP 430.1325800.2018:

- Flat slabs are predominantly used for spans up to **6–8 m**.
- For spans exceeding **7 m**, it is recommended to use high-strength prestressing reinforcement (prestressed concrete).

### **Summary:**

To realize an 8.5 m span without beams, it is necessary to either **increase the slab thickness to at least 250–280 mm** (with a mandatory deflection check), or switch to the use of **prestressed concrete** (clause 5.2.13), or introduce **capitals/beams**. Leaving a 200 mm flat slab with conventional reinforcement is prohibited by the codes due to the guarantee of excessive deflections and cracks.

---

**Question 9: During an inspection of an existing building, cracks with an opening width of 0.4 mm were found in the beams. The building is in normal operation. Is this acceptable, or is strengthening required?**

---

### **1. Verdict (Correct Answer)**

**Answer:** A crack opening of 0.4 mm in the beams of an existing building generally indicates a **serviceable** (or standard, if the load was short-term) technical condition, but it is considered a **defect** because it exceeds the design code requirements for long-term crack opening (0.3 mm).

- **Operation:** Permissible (the building is in normal operation).

- **Strengthening:** Not required (unless a verification calculation reveals a deficit in load-bearing capacity).
- **Measures:** Repair of the cracks is required (injection, grouting) to restore the anti-corrosion protection of the reinforcement.

**Explanation:** There is a discrepancy between design codes (SP 63, where the limit is 0.3 mm) and codes for assessing the condition of existing buildings (GOST 31937, SP 454). For existing buildings, a 0.4 mm crack typically does not classify the structure as being in a "limited serviceable state" (which would require strengthening/load restriction), provided there are no signs of concrete failure or reinforcement rupture.

Being overly strict is also incorrect.

---

## 2. Facts from Documents and Hallucination Check (Ground Truth Facts)

Here are the specific clauses from documents that confirm or refute the models' claims.

### A. SP 454.1325800.2019 "Residential Apartment Buildings..."

Used by Models A, B, C.

- **Fact #1 (Surprisingly high allowances):**
  - Table 5.14: For reinforced concrete beams and girders.
  - Criterion for a **limited serviceable state** (normal/shear cracks): crack width of **1.4 – 2.0 mm**.
  - Criterion for an **emergency/unsafe state**: more than **2.0 mm**.
  - **Conclusion:** The assertions by Models A and B that 0.4 mm is far from the threshold for a limited serviceable state (1.4 mm) according to this SP are **CORRECT**. This is not a hallucination; this is the text of the document (which is oriented towards low-rise housing and mass assessment).

### B. SP 63.13330.2018 "Concrete and Reinforced Concrete Structures"

Used by Models C, D.

- **Fact #2 (Design limits):**
  - Clause 8.2.6: The maximum permissible crack opening width  $a_{(crc,ult)}$ :
    - Under long-term action of loads (long-term opening): **0.3 mm**.
    - Under short-term action of loads: **0.4 mm**.
  - **Conclusion:** A 0.4 mm crack is the limit for short-term loads and exceeds the norm (0.3 mm) for permanent loads. Model D is correct in stating that this is a violation of design codes.

## C. GOST 31937-2024 "Buildings and Structures. Rules for Inspection..."

The primary document for inspections (replaces the 2011 version).

- **Fact #3 (Defect classification):**

- Appendix V, Table V.1 (item 1.6): Normal cracks in flexural members with a width greater than 0.3 mm may indicate a **limited serviceable state** "if there is a reduction in load-bearing capacity..."
  - **Important nuance:** An opening >0.3 mm is in itself a trigger for a verification calculation, but not an automatic sentence for strengthening, unless there is a risk of failure.
- 

### Model A

#### **Verdict: PERMISSIBLE.**

Operation is possible, and strengthening of the structure is not required. It is recommended to seal the cracks (injection/grouting) to protect the reinforcement from corrosion.

#### **Justification:**

- **Classification of Technical Condition (SP 454.1325800.2019):**

According to the provided SP 454.1325800.2019 "Residential Apartment Buildings. Rules for assessing emergency and limited serviceable technical condition," the assessment of beams (girders) is based on Table 5.14 ("Criteria for assessing the technical condition of individual floor beams and reinforced concrete girders"):

- The criterion for transitioning to a **limited serviceable state** (when repair/strengthening and monitoring are required) for normal and shear cracks in the tension zone is a crack width of **1.4 – 2.0 mm**.
- The criterion for an **emergency/unsafe state** is more than **2.0 mm**.  
Since the width of the detected cracks is 0.4 mm, which is significantly less than the threshold value of 1.4 mm, the condition of the beams based on this sign is classified as **serviceable** (normal operation is not compromised).

- **Production Standards (GOST 18980-2015):**

Although GOST 18980-2015 (clause 4.4.6) sets the maximum permissible crack width during manufacturing (acceptance of new products) at no more than 0.1–0.2 mm, for the inspection of existing buildings, the norms for assessing technical condition (SP 454, GOST 31937) are used. These norms permit larger crack openings if they do not threaten collapse.

**Summary:** A 0.4 mm crack in an existing building is not a critical defect requiring structural strengthening of the beam's load-bearing capacity, as it does not exceed the limit values for a limited serviceable state according to SP 454.1325800.2019.

---

## **Model B**

Based on the provided regulatory documents, the assessment of the technical condition of beams with cracks 0.4 mm wide in an existing building (using residential apartment buildings as an example) is as follows:

### **1. Verdict**

Cracks with a width of 0.4 mm in beams are not a basis for classifying the structure as being in a limited serviceable or emergency state. According to the current criteria, these values are within limits that do not require mandatory strengthening of the structure based on the sign of crack width.

### **2. Justification (according to SP 454.1325800.2019)**

In accordance with section 5.3.11 and Table 5.14 "Criteria for assessing the categories of technical condition of floor beams, girders (B)," the following threshold values are established for reinforced concrete structures:

- For normal and shear cracks in the tension zone:
  - **Limited serviceable state:** crack width from **1.4 to 2.0 mm**.
  - **Emergency/unsafe state:** crack width **more than 2.0 mm**.
- For cracks in the support area of the structure:
  - **Limited serviceable state:** crack width from **1.0 to 1.5 mm**.
  - **Emergency/unsafe state:** crack width **more than 1.5 mm**.

Since the detected crack width (0.4 mm) is significantly less than the minimum threshold of 1.0 mm established for a limited serviceable state, the structure is formally recognized as **serviceable** (in the absence of other defects listed in Table 5.14, such as deflections greater than 1/100 of the span or reinforcement corrosion exceeding 15%).

### **3. Additional Conditions and Limitations**

- **Scope of Application:** These norms (SP 454.1325800.2019) directly apply to residential apartment buildings.
- **Crack Formation:** According to Table 8.1 (from the context of GOST R 59622-2021, applied by analogy to general reliability principles), the formation of cracks that do not disrupt normal operation belongs to the second group of limit states. These are states in which "the need arises to limit throughput capacity or reduce the design service life," but not instantaneous failure.
- **Exclusion of Special Norms:** Requirements from documents for high-speed railways (SP 453.1325800.2019) or bridge structures (GOST R 59622-2021), where crack opening limits can be 0.015–0.2 mm, are not applicable to civil buildings and

cannot serve as a basis for requiring the strengthening of beams in a standard building.

**Conclusion:** Strengthening is not required, as the crack width of 0.4 mm does not reach the regulatory criteria (1.0–1.4 mm) that determine the need for repair work or operational restrictions.

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## Model C

Based on the provided regulatory data and general requirements for reinforced concrete structures (SP 63.13330, SP 164.1325800, SP 454.1325800), the answer to your question is as follows:

### 1. Admissibility of the Crack Width

For most reinforced concrete structures operated indoors (normal environment), the maximum permissible width of short-term crack opening is **0.4 mm**, and for long-term opening, it is **0.3 mm** (according to SP 63.13330). Thus, a 0.4 mm crack is at the boundary or slightly exceeds the standard limit for normal conditions.

### 2. Assessment of Technical Condition

According to the criteria table from SP 454.1325800.2019 (#2), the condition of the beam is considered:

- **Limited serviceable** with a crack width from **1.4 to 2.0 mm**.
- **Emergency/unsafe** with a crack width **over 2.0 mm**.

Since the detected cracks (0.4 mm) are significantly smaller than these values, the condition of the structure is most likely classified as **serviceable** (provided there are no other defects).

### 3. Is strengthening necessary?

According to SP 164.1325800.2014 (#1) and SP 349.1325800.2017 (#4):

- Strengthening is not mandatory if the actual crack opening exceeds the permissible values, but verification calculations confirm a reserve of load-bearing capacity and the cracks do not pose a risk of failure.
- The decision on the need for strengthening is made only on the basis of a verification calculation. If the calculation shows that the beam's strength is sufficient, strengthening is not required.

### 4. Necessary Measures

Even if strengthening is not required, you are obligated to carry out preventive work:

- **Corrosion Protection:** According to SP 31-114-2004 (#3), any cracks must be repaired by cleaning them out and filling with cement mortar or by injection. This is

necessary to prevent moisture access to the reinforcement and the development of corrosion.

- **Monitoring:** If the cracks are "live" (developing), it is necessary to install tell-tales (crack monitors) and determine the cause of their appearance.

**Conclusion:** Strengthening with a 0.4 mm opening is generally not required if a verification calculation confirms the beam's strength. However, the cracks must be sealed (injected or grouted) to protect the reinforcement from corrosion.

---

## Model D

👉 It depends on the service class and the purpose of the beams.

But for a standard heated building, a crack opening of 0.4 mm in reinforced concrete beams, as a rule, **EXCEEDS** the permissible values and requires at least a verification calculation, and more often, repair/strengthening measures.

Let's break it down according to the current SP 63.13330.2018 "Concrete and Reinforced Concrete Structures."

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### 1. Regulatory Limits for Crack Opening

#### SP 63.13330.2018, clause 7.3.6 + Table 7.3

For elements made of ordinary reinforced concrete (beams, girders, slabs):

◆ Under normal operating conditions (dry/moderately humid rooms, no aggressive environment):

- maximum permissible crack opening width:  
**w ≤ 0.3 mm**
    - ◆ In high humidity / risk of corrosion:
  - **w ≤ 0.2 mm**
    - ◆ For prestressed structures:
  - even stricter (usually ≤ 0.1–0.2 mm)
- 

### 2. What your 0.4 mm means

Effectively:

👉 **0.4 mm > 0.3 mm**

This means:

✖ **Exceeds the standardized crack opening.**

✖ **Violation of SP 63 requirements for crack resistance** (second group of limit states).

Even if:

- the building is "operating normally"
  - there are no visible deformations
  - the client says "but it's standing"
    - this is not a valid argument from the standpoint of the codes.
- 

### **3. An important point: this is no longer "cosmetic"**

0.4 mm cracks in beams mean:

- the stiffness of the element has been reduced
- corrosion of the reinforcement is possible
- crack resistance has likely been exhausted
- deflections may increase over time (creep)

According to the SP, this is already a defect, not an acceptable condition.

---

### **4. Is strengthening necessary?**

Formally, according to regulatory logic:

The minimum that is **MANDATORY**:

👉 A **verification calculation** of the beams based on their actual cross-section and reinforcement.

👉 An **assessment** of the causes of crack formation.

👉 **Classification of the defect** (based on the inspection results).

This is done as part of an inspection according to SP 13.13330.

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Further options are possible:

✓ If the calculation shows a reserve of load-bearing capacity:

— It may be acceptable to limit measures to:

- **injecting the cracks**
- **protecting the reinforcement**
- **monitoring**

✗ If a reserve is not confirmed (which is often the case with 0.4 mm):

👉 **Strengthening is required** (jacketing, section enlargement, composites, etc.).

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## Conclusion as a Chief Project Engineer

⚠ 0.4 mm for beams is **NOT PERMISSIBLE** according to SP 63.13330.2018.  
This exceeds the standardized crack opening.

This means:

- 👉 A calculation-based assessment is necessary.
- 👉 At a minimum — repair + protection.
- 👉 If load-bearing capacity is insufficient — strengthening.

Leaving it "as is" without a calculation-based confirmation is not allowed.

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### One-line summary

Cracks of 0.4 mm in RC beams exceed the permissible 0.3 mm according to SP 63 — a calculation-based assessment is required, and, as a rule, repair/strengthening; simply deeming the condition acceptable is not allowed.

**Question 10: We are designing a pile field for a 12-story building. The geological survey showed Type II collapsible soil. Can we use driven piles, or are bored piles with an enlarged base mandatory?**

**Correct Answer (Ground Truth):**

The use of driven piles in Type II collapsible soil conditions **IS PERMISSIBLE**. There is **NO mandatory requirement** in the codes to exclusively use bored piles with an enlarged base.

**Key conditions for driven piles:**

- **Full Penetration:** The piles must completely penetrate the collapsible stratum and bear on non-collapsible soils (clause 9.3 of SP 24).
  - **Type of Bearing Soil:** The piles must be embedded into dense soils with a specific liquidity index ( $I_L$ ).
  - **Negative Friction:** The calculation of bearing capacity must account for the negative skin friction forces that arise when the soil around the pile subsides (clauses 9.9, 9.11 of SP 24).
- 

## 2. Verified Clauses and Quotes (Fact-checking)

Below is the data that is confirmed by the text of the documents. If a model refers to these clauses differently, it is an error.

### A. SP 24.13330.2021 "Pile Foundations"

This document is central to the question.

- **Fact #1 (Requirements for the lower end and  $I_L$ ):**

- Clause 9.3: "The lower ends of piles must be embedded in rock, dense and medium-dense sands, and clayey soils with a liquidity index in a water-saturated state of...  $I_L < 0.4$  — for driven piles... when  $s_{(sl,g)} \leq s_u$  in Type II soil conditions;  $I_L < 0.2$  — for driven piles... when  $s_{(sl,g)} > s_u$  in Type II soil conditions."
- **Conclusion:** The code directly establishes requirements specifically for **driven piles** in Type II conditions, which confirms their permissibility.
- **Fact #2 (Leader Holes):**
  - Clause 9.4: "In the event that... the installation of driven piles into collapsible soils is difficult, the project must provide for the creation of leader holes..."
  - **Conclusion:** The code provides a technological solution to enable driven piles to penetrate dense collapsible soil.
- **Fact #3 (Negative Friction):**
  - Clause 9.9: "The bearing capacity of piles... in Type II soil conditions should be calculated taking into account negative friction forces..."
  - Clause 9.11: Indicates that the bearing capacity is determined as the difference between the compressive capacity and the pull-out capacity of the part of the pile within the collapsible stratum (negative friction).

## B. SP 22.13330.2016 "Bases of Buildings and Structures"

- **Fact #4 (Definition of Type II):**
  - Clause 6.1.9: Type II — "soil conditions in which, in addition to soil settlement from external load, settlement from its own weight is also possible, and its magnitude exceeds 5 cm."
- **Fact #5 (Terminology):**
  - Clause 3.36: Provides the official definition of negative (downdrag) friction forces.

### Model A

**Briefly, as a Chief Project Engineer, strictly according to the codes:**

👉 **Driven piles can be used.**

👉 The mandatory use of bored piles with an enlarged base in Type II collapsible soils **is not established by regulations**.

However, the decision must be justified by calculations that account for the soil's collapsibility.

Let's break it down by the SP (Set of Rules).

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## **1 Regulatory Basis**

Main documents:

- SP 24.13330.2021 "Pile Foundations"
  - SP 22.13330.2016 (as amended) "Bases of Buildings and Structures"
- 

## **2 What Type II Collapsible Soil Means**

According to SP 22.13330, Section 5:

Type II collapsible soils are soils that:

- subside upon soaking,
  - and this subsidence is possible both from its **own weight** and from additional load.  
So, the problem is not the type of pile, but:
  - possible additional settlement of the foundation,
  - negative skin friction along the lateral surface of the piles.
- 

## **3 There is no prohibition on driven piles**

SP 24.13330.2021 does not contain a provision prohibiting the use of driven piles in Type II collapsible soils.

On the contrary, the codes stipulate that:

in the presence of collapsible soils, the pile calculation must be performed taking into account possible subsidence and negative friction.

This means:

- 👉 **any type of pile is permitted**
  - 👉 **provided it is justified by calculations.**
- 

## **4 What Must Be Considered (Key Point)**

SP 24.13330.2021, Section 7

In the presence of collapsible soils, it is necessary to account for:

- ✓ **negative skin friction**
- ✓ reduction in bearing capacity
- ✓ additional foundation settlement
- ✓ possible soil soaking

This applies to both driven and bored piles.

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## **5 Are bored piles with an enlarged base mandatory?**

**No.**

An enlarged base (bell) is used to:

- increase the end-bearing capacity
- engage dense underlying soils

But the standard does not say:

"in Type II collapsible soils, bored piles with an enlarged base are mandatory."

**There is no such requirement.**

The type of pile is selected based on:

- geology
- depth of the stable layer
- bearing capacity calculation
- technological conditions

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## **6 When driven piles might even be preferable**

In practice, in collapsible soils:

- driven piles are often effective,
- as they compact the surrounding soil,
- and reach the dense layer more quickly.

But one must consider:

- negative friction,
- possible subsidence of the surrounding soil mass.

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## **Final Decision of the Chief Project Engineer**

 **Driven piles CAN be used.**

 **There is NO mandatory requirement for bored piles with an enlarged base.**

But it is mandatory to:

- perform calculations accounting for collapsibility (SP 22)
- account for negative friction (SP 24)
- check for settlement
- if necessary, implement measures for water protection or foundation stabilization.  
Without a calculation-based justification, it is not allowed.

## One-line summary

In Type II collapsible soils, driven piles are permitted. There is no regulatory requirement to use only bored piles with an enlarged base — the pile type is determined by calculation according to SP 22 and SP 24, taking into account negative friction and subsidence.

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## Model B

Based on SP 24.13330 ("Pile Foundations"), the answer to your question is as follows:

**You can use driven piles in Type II collapsible soils; they are not prohibited.** Moreover, bored piles with an enlarged base are not mandatory; they are just one of the possible design solutions.

Here are the key regulatory requirements and conditions for your case (12-story building, Type II collapsibility):

### 1. Mandatory Penetration of the Collapsible Stratum

For a 12-story building (which is not considered low-rise) in Type II soil conditions, the piles must **completely penetrate the entire collapsible stratum** and be embedded into the underlying non-collapsible soils (SP 24.13330.2011 #5). Bearing piles on collapsible soil in Type II conditions is not permissible for such buildings.

### 2. Requirements for the Soil Beneath the Pile Toe

According to SP 24.13330.2011 (#3), for driven piles in Type II soil conditions, requirements are set for the liquidity index ( $I_L$ ) of the soil into which they are embedded:

- If the settlement from the soil's own weight ( $s_{(sl,g)}$ ) exceeds the maximum permissible settlement ( $s_u$ ), then the liquidity index of the soil under the toe of a driven pile must be  $I_L < 0.2$ .
- For bored piles under the same conditions, the requirements are stricter —  $I_L \leq 0$ .

### 3. Specifics of Pile Behavior in Type II Conditions (Negative Friction)

In Type II collapsibility, when designing any piles (driven or bored), you are **obligated to account for negative skin friction**.

- Upon soaking, the soil will begin to subside under its own weight and will "drag" the pile down, creating an additional load.
- Driven piles often have an advantage in such soils, as they further compact the surrounding space during installation; however, their bearing capacity must be confirmed by a calculation that includes this negative load.

### 4. Choosing Between Pile Types

- **Driven Piles:** Permissible if it is technically possible to drive through the collapsible stratum to the bearing layer. In collapsible soils, driving into **leader holes** is often

used (SP 46.13330.2012 #4) to ensure the pile reaches the design depth without damaging the pile head.

- **Bored Piles (including with an enlarged base):** Used if the bearing layer is very deep or if the loads from a 12-story building are too high for standard driven piles. The enlarged base is created to increase bearing capacity but is not a regulatory requirement specifically for "collapsibility."

**Summary:** You can use driven piles. The main thing is to ensure they pass through the entire collapsible stratum and to perform a calculation for the negative skin friction of the soil. If the calculated load on a driven pile turns out to be too low due to the subsidence of the surrounding soil, then it is advisable to consider bored piles (with or without an enlarged base).

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## Model C

### Verdict: PERMISSIBLE.

The use of driven piles in Type II collapsible soil conditions is permitted. There is no requirement in the codes for the mandatory use of only bored piles with an enlarged base. However, strict requirements are imposed on driven piles regarding the full penetration of the collapsible stratum and accounting for negative friction.

### Justification:

Based on SP 24.13330.2021 "Pile Foundations":

- **Possibility of Use:**

Section 9 "Specifics of designing pile foundations in collapsible soils" contains no prohibition on the use of driven piles. Moreover, clause 9.3 directly specifies the requirements for the liquidity index of the soil under the toe for driven piles in Type II soil conditions:

*"The lower ends of piles must be embedded in rock, dense and medium-dense sands, and clayey soils with a liquidity index in a water-saturated state of: ... **IL < 0.4** – for driven piles... when  $ssl,g \leq su$  in Type II soil conditions; **IL < 0.2** – for driven piles... when  $ssl,g > su$  in Type II soil conditions."*

- **Full Penetration Condition:**

According to clause 9.3, pile foundations should be used in cases where it is possible for the piles to penetrate all layers of collapsible soils. The piles must bear on non-collapsible soil.

- **Accounting for Negative Friction:**

In Type II collapsibility conditions (where settlement from the soil's own weight  $> 5$  cm is possible), it is necessary to perform a pile calculation that takes into account negative friction forces (downdrag) arising from the settlement of the soil around the pile.

- **Clause 9.9:** "The bearing capacity of piles based on the foundation soils in Type II soil conditions should be calculated taking into account negative friction forces..."
- **Clause 9.11, a):** "The bearing capacity... of piles in Type II soil conditions... should be determined... as the difference between the bearing capacity of piles of length  $l$  under compressive load and the pull-out capacity of piles of length  $hsl$  ( $hsl$  – depth of the collapsible stratum)..."
- **Installation Technology (Leader Holes):**  
If the collapsible soils are hard and driving is difficult, the codes prescribe the use of leader holes.
  - **Clause 9.4:** "In the event that... it is established that the installation of driven piles into collapsible soils is difficult, the project must provide for the creation of leader holes..."

**Summary:** You can use driven piles if they penetrate the entire thickness of the collapsible soil, bear on a reliable bearing layer (in accordance with clause 9.3), and pass the bearing capacity calculation, which must include the subtraction of negative friction forces along the lateral surface within the collapsible zone.

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## Model D

Based on the provided regulatory documents (SP 24.13330.2021, SP 50-102-2003, SP 21.13330.2012) on the issue of constructing a pile foundation in Type II collapsible soils for a 12-story residential building, I report the following:

### 1. Direct Answer

The use of driven piles in Type II collapsible soils is **PERMISSIBLE**. The regulatory framework does not establish an exclusive obligation to use only bored piles with an enlarged base. However, the choice of pile type is strictly limited by the condition of fully penetrating the collapsible stratum.

### 2. Regulatory Justification and Conditions for Use

#### A. Requirement for Soil Penetration (SP 24.13330.2021, clause 9.3)

In areas with collapsible soils where soaking is possible, pile foundations should be designed so that the piles completely penetrate all layers of collapsible soils whose characteristics deteriorate upon soaking.

- **Condition for the lower end:** The lower ends of piles (of any type) must be embedded in:
  - rock;
  - dense and medium-dense sands;

- clayey soils with a liquidity index in a water-saturated state that meets stability requirements.

### **B. Specifics of Driven Piles (SP 50-102-2003, clause 15.2.12)**

When driving piles into dense or clayey soils (which include collapsible loess soils), it is recommended to use **leader holes** to prevent heave of previously installed piles and damage to structures.

### **C. Specifics of Type II Collapsibility (SP 21.13330.2012, clause 6.1.1)**

Type II soils are characterized by the possibility of settlement from their own weight upon soaking. This mandates that the calculation of pile bearing capacity must account for **negative friction forces** that arise along the lateral surface of the pile as the surrounding soil subsides.

## **3. Comparison of Options Based on the Text of the Codes**

- **Driven Piles:** Permissible if their length is sufficient to completely penetrate the collapsible stratum and be embedded into the bearing layer. If the thickness of the collapsible layer is large (characteristic of Type II), the use of driven piles may be limited by the technical capabilities of the pile-driving equipment.
- **Bored Piles (SP 45.13330.2017, clause 12.2.1):** Used as an alternative that allows for reaching greater depths and providing high bearing capacity due to diameter or an enlarged base, but their use is not a non-alternative requirement.

### **Summary**

You can use driven piles if the design solution ensures:

- **Complete penetration** of the Type II collapsible layer.
- **Embedment into non-collapsible soil** according to clause 9.3 of SP 24.13330.2021.
- **Accounting for negative soil friction** in the bearing capacity calculations.

If the thickness of the collapsible soil exceeds the length of standard driven piles, the use of bored piles will become a technical necessity to meet the requirement of penetrating the entire stratum, but not as a direct prohibition on driven piles as a type of structure.