Seismic Design in Australia

Are You Complying With the National Construction Code and Earthquake Standard?

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INTRODUCTION

Although severe earthquakes do not frequently strike Australia, regular earthquake activity does occur here. Australia records 100 earthquakes with a magnitude of 3.0 or higher annually on average.[1]

Earthquakes with a magnitude of 5.0 or higher, such as the 1989 earthquake in Newcastle, which resulted in the tragic deaths of 13 people and saw more than 160 people injured, occur every one to two years. It was only in October last year that a magnitude-5.0 earthquake on the Great Ocean Road rattled parts of Melbourne.[2]

Considering the potential risks associated with seismic activity, all buildings need an assessment of their seismic design requirements in accordance with the National Construction Code (NCC). The NCC mandates that all buildings adhere to the Earthquake Standard, also known as AS 1170.4:2007 “Structural design actions Part 4: Earthquake actions in Australia”, to differing degrees.

Seismic design aims to protect human life and reduce structural damage in the event of an earthquake. In accordance with the applicable standards, non-structural elements like suspended ceilings must also adhere to the seismic design requirements, in addition to the main structural frame. Below, we survey who is responsible for seismic compliance and summarise the relevant Australian codes, standards and regulations.

WHO IS RESPONSIBLE FOR SEISMIC COMPLIANCE?

It is the duty of all those engaged in the planning, designing, and construction of buildings to ensure compliance with the seismic requirements in the NCC and relevant Australian standards. For example, architects and designers need to consider appropriate detailing and specification in accordance with AS 1170.4.

During construction, it is the responsibility of builders to make sure that all non-structural elements are properly considered for earthquake loads in their design and that the buildings they build comply with all seismic requirements. They also have to oversee the installation of compliant structural and non-structural components on site.

Multi-storey buildings must have structural engineering input to allow for inter-story drift. Engineering must also engage with suppliers and manufacturers regarding mechanical, electrical, and architectural systems and components to make sure they have the necessary performance properties to withstand seismic activity.

Finally, building surveyors are responsible for ensuring that documentation sufficiently covers AS1170.4 detailing and that the design appropriately considers seismic actions.

OVERVIEW OF AUSTRALIAN BUILDING CODES AND STANDARDS

According to the NCC Performance Requirements for structures, buildings must perform adequately under all reasonable, expected, and extreme design actions, including earthquake actions. The Deemed-to-Satisfy Provisions of the NCC require buildings to be designed and constructed in compliance with AS 1170.4 to meet such requirements. The relevant provisions are set out in Part B1 Structural provisions.

In general, all buildings must adhere to AS 1170.4. The only exceptions are Importance Level 1 buildings (small, isolated structures that are rarely inhabited) and certain domestic Class 1a or 1b buildings that are less than 8.5 metres tall and comply with Appendix A and the applicable design standards.

Different requirements apply to structural and non-structural components, respectively. The design of structural components must incorporate a seismic force-resisting system with a well-defined load path, or paths, to transfer both gravity loads and the earthquake actions produced in the earthquake to the supporting foundation soil. Meanwhile, non-structural components and their fastenings must be designed for horizontal and vertical earthquake forces in accordance with Section 8 of AS 1170.4.

In June 2020, a new standard for suspended ceilings called AS/NZS 2785:2020 “Suspended Ceilings – Design and Installation” was released, coinciding with the increased focus on seismic compliance. This standard provides valuable guidance on seismic restraints in relation to ceilings and partitions.

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WHAT DESIGN LOADING APPLIES?

Earthquake actions used in design must be appropriate to the type of building, its intended use, exposure to earthquake shaking, and design working life. When determining the applicable design loading, several factors need to be considered. The factors include:

- location of the site to determine the Hazard Design Factor (see Section 3 of AS 1170.4);
- Importance Level of the building (Levels 1 to 4), depending on the type and purpose of the building being constructed (see Table B1D3a of NCC Vol.1) ;
- Site Sub-Soil classification (see Section 4 of AS 1170.4); and
- structure height.

Based on these factors, the Earthquake Design Category (EDC) can be determined using Table 2.1 in AS 1170.4. Note that a structural engineer must be engaged to determine which EDC applies to the building.

Source: AS 1170.4

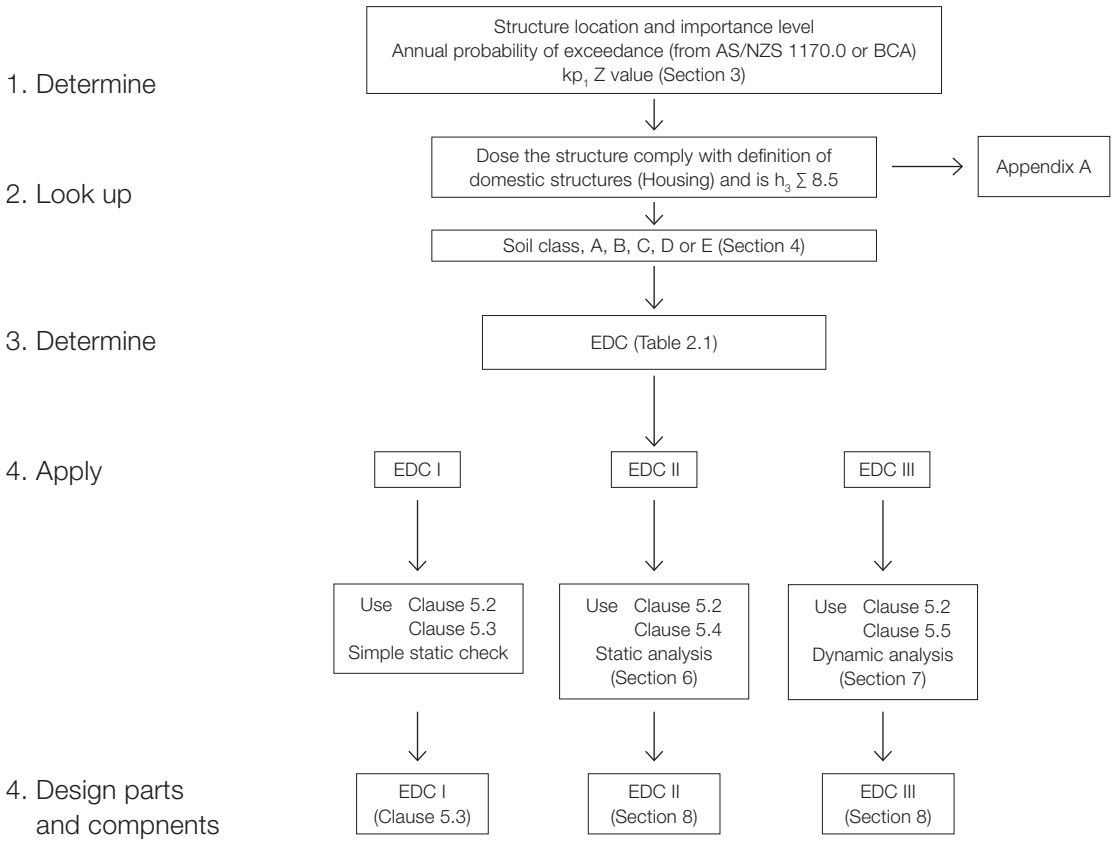


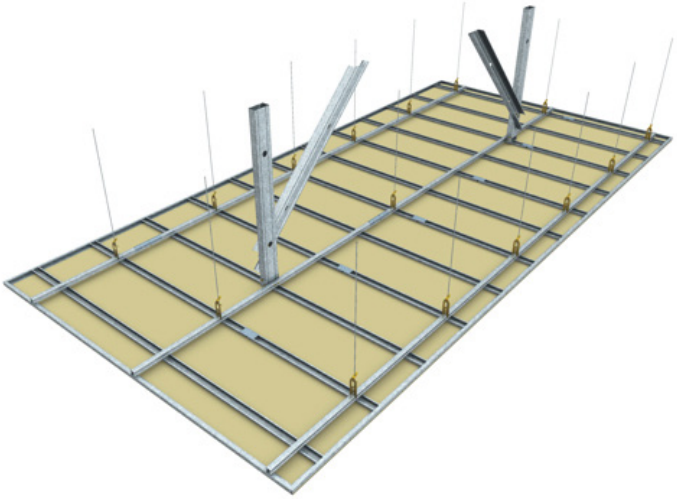
FIGURE 2.2 FLOW DIAGRAM - DESIGN PROCEDURE

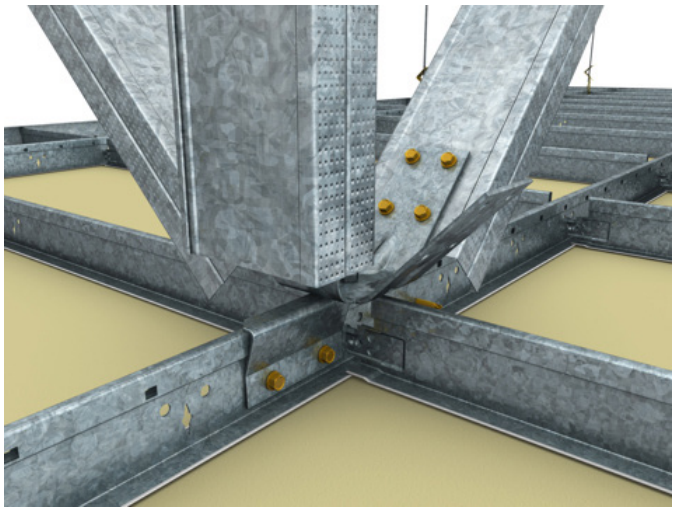
DESIGN OF PARTS AND COMPONENTS

Section 8 of AS 1170.4 details the non-structural building elements and components that must be engineered to withstand both vertical and horizontal seismic forces for Class 2 to 9 buildings. The following is a list of non-structural components that need to have earthquake loads taken into account:

- walls that are not part of the seismic-force-resisting system;
- appendages, including parapets, gables, verandas, awnings, canopies, chimneys, roofing components (tiles, metal sheeting), containers and miscellaneous components;
- connections (fasteners) for wall attachments, curtain walls, and exterior non-loadbearing walls;
- partitions;
- floors;
- ceilings; and
- architectural equipment, including storage racks and library shelves with a height over 2.0 m.

AS 1170.4 requires that the design of the aforementioned parts and components be completed for earthquake actions using one of the techniques described in Section 8. This includes using established principles of structural dynamics or using general or simplified methods expressed in Clauses 8.2 or 8.3 of Section 8.[3]





RECENT REGULATORY CHANGES

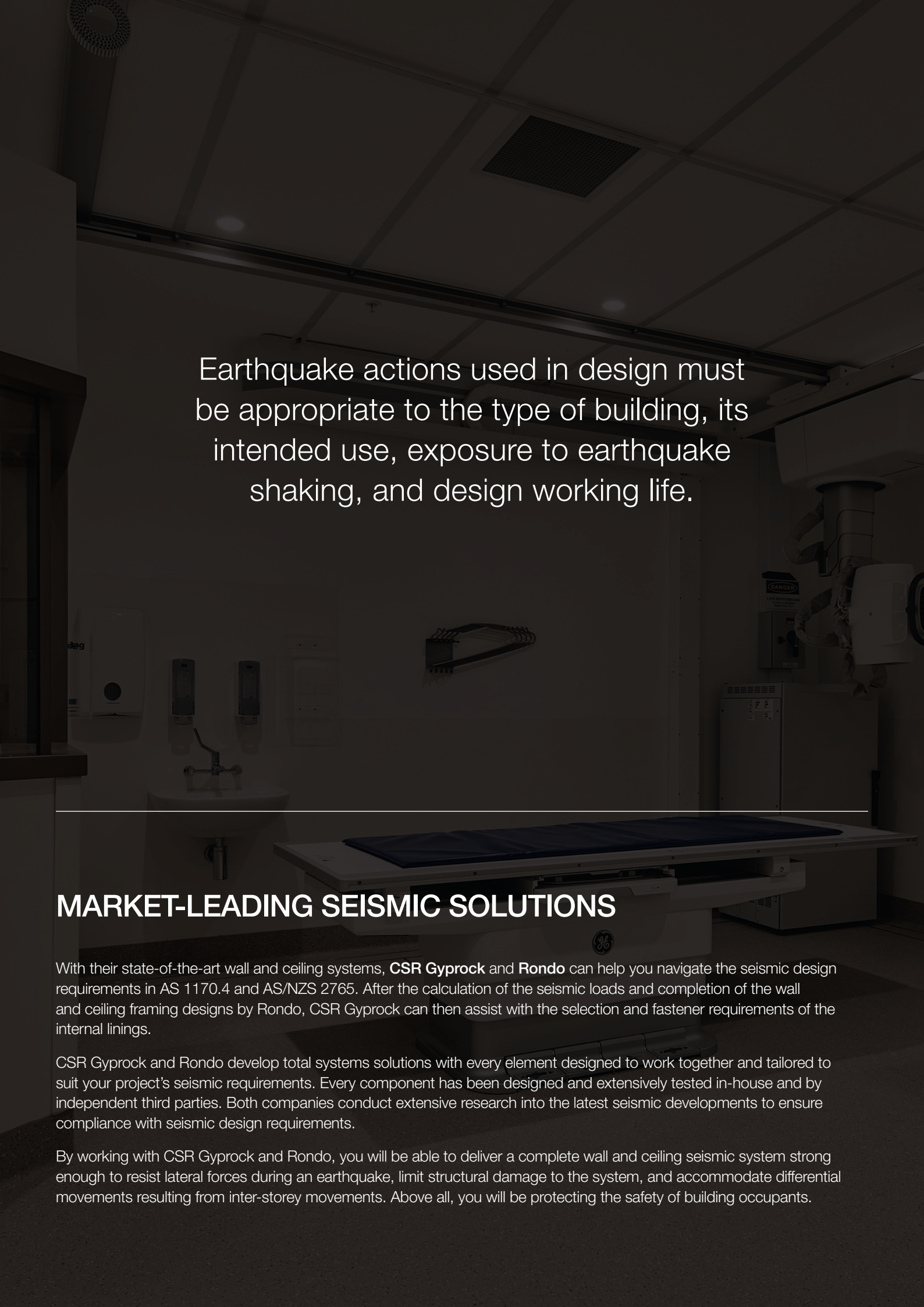
In late 2023, Standards Australia's BD-006 committee released a draft of an amended version of AS 1170.4 for comment. The amendment's primary goals are to update the seismic hazard map and include general editorial changes to increase clarity and eliminate ambiguity.

While changes to AS 1170.4 are still being considered, architects and designers should note the significant update that AS/NZS 2785 received in 2020. The previous 2000 version of the standard included general guidance on earthquake design for suspended ceilings, but many important details were lacking or not clear. This included how ceilings would interact with other components and the required clearances; methods for achieving adequate seismic restraint; and interstorey drift and clearance requirements.

The updated 2020 standard provides clearer guidance and specifications covering a number of design aspects. This includes consideration of the primary structure to support ceiling loads; clarification on imposed actions; seismic clearance requirements for adjacent elements and penetrations; and serviceability requirements for square-set joints and cornices.

Notably, the 2020 standard specifies partition wall restraint methods and requirements regarding when it is and is not appropriate to have ceilings fixed to partition walls. In summary, partitions should not be attached to the ceiling unless the ceiling has been designed to provide restraint. If the ceiling is attached to the partition wall, the wall needs to be braced to the soffit and able to support the ceiling actions.

If partition walls are fixed to the suspended ceiling, a seismic event may cause the ceiling to collapse due to the horizontal deflection of these components. Partition walls must have independent bracing and be supported through the ceiling with seismic gaps that accommodate the calculated loads.



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MARKET-LEADING SEISMIC SOLUTIONS

With their state-of-the-art wall and ceiling systems, **CSR Gyprock** and **Rondo** can help you navigate the seismic design requirements in AS 1170.4 and AS/NZS 2765. After the calculation of the seismic loads and completion of the wall and ceiling framing designs by Rondo, CSR Gyprock can then assist with the selection and fastener requirements of the internal linings.

CSR Gyprock and Rondo develop total systems solutions with every element designed to work together and tailored to suit your project's seismic requirements. Every component has been designed and extensively tested in-house and by independent third parties. Both companies conduct extensive research into the latest seismic developments to ensure compliance with seismic design requirements.

By working with CSR Gyprock and Rondo, you will be able to deliver a complete wall and ceiling seismic system strong enough to resist lateral forces during an earthquake, limit structural damage to the system, and accommodate differential movements resulting from inter-storey movements. Above all, you will be protecting the safety of building occupants.

REFERENCES

1 Australian Climate Service. “Earthquakes.” ACS. https://www.acs.gov.au/pages/earthquakes (accessed 5 February 2024).

2 Sambul, Namja. “Victoria rattled by magnitude 5 earthquake.” The Age. https://www.theage.com.au/national/victoria/victoria-rattled-by-magnitude-5-earthquake-20231022-p5ee1m.html (accessed 5 February 2024).

3 Australian Building Codes Board. “Design of non-structural building elements for earthquake forces.” ABCB. https://www.abcb.gov.au/news/2019/design-non-structural-building-elements-earthquake-forces (accessed 5 February 2024).

All information provided correct as of March 2024

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