CHAPTER 39

Weather Related Delays and It's Impact in Construction

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ABSTRACT

Construction projects in India, particularly infrastructure developments like highways, bridges, and buildings, are frequently plagued by delays caused by adverse climatic conditions such as monsoons, heavy rains, floods, and cyclones. These delays often lead to disputes between contractors and clients, resulting in arbitration proceedings. This study analyses a collection of arbitration awards from various cases, focusing on how climatic factors influence dispute outcomes. Drawing from past case histories, it identifies key intrinsic (case-specific facts) and extrinsic (arbitrator-related and psychological) factors affecting decisions. The ultimate goal is to develop a framework that helps parties predict outcomes, decide whether to raise claims, and encourage out-of-court settlements, thereby reducing the burden on the judiciary.

Keywords: Construction delays, climatic conditions, monsoons, arbitration awards, dispute resolution, India infrastructure, predictive framework.

1.0 Introduction

Development of infrastructure is critical to economic growth of India thanks to such large-scale projects as the Bharatmala Pariyojana and redevelopment of cities. In spite of this growth, building projects are still prone to timeline slippage and budget over-runs and unfavourable weather has become one of the major and most legally demanding factors. The force majeure events like monsoons, floods and cyclones are usually categorized under Force Majeure, but vague contractual definitions leave contractors to bear the risks of the season when they are trying to demonstrate exceptional circumstances.

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India has various topography, and these problems are compounded by the fact that weather inconveniences are coupled with administrative setbacks. In turn, the disputes are often taken to arbitration where tribunals have to decide whether the weather effects were predictable or uncommon. This paper examines 14 arbitration awards and suggests a Decision-Making Framework to bring more alignment between weather risks and the contractual liability in Indian infrastructure project.

2.0 Literature Review

The two are the meteorological volatility and the contractual liability, which have been widely recorded to conflict in the construction management around the world (Chan and Kumaraswamy, 1997). According to most scholarly references, adverse weather is one of the key causative agents of the project overruns, and the legal implications of such incidents significantly vary across jurisdictions (Doloi et al., 2012). The review examines the evolution of weather-impact analysis, where it transcends the outdated qualitative analysis of the occurrence to presently, the data-oriented analysis, and identifies the gap in foreseeability that still resides in the Indian legal arena (Iyer and Jha, 2006).

2.1 Weather is the first disruption factor

The weather has always been ranked at the first position as causes of delays during construction in the literature (Chan and Kumaraswamy, 1997). The second variable that is deemed to be of primary significance in Jordan is weather conditions (15.3% following terrain) (Al-Hazim et al., 2017). According to the world research, unforeseen extreme weather can raise the life of the project by 5-20 percent (Nguyen et al., 2010). In India, the impact of the monsoon is also relatively extreme since seasonal rainfalls and floods usually delay important processes on the critical path like earthmoving and foundation (Doloi et al., 2012).

2.2 Decision support and WEATHER system

Due to technological progress, systems like the so-called WEATHER (Weather Evaluation and Analysis of Tracking High-impact Environmental Risks) system have been created (Ballesteros-Perez et al., 2017). It is a technical process which combines previous meteorological information and project scheduling software like Primavera or MS Project (Ballesteros-Perez et al., 2017). It uses the stochastic modelling concept to model probable delays and incorporate them into project baseline schedules before the commencement (Nguyen et al., 2010). These models are dynamic and need a specific sensitivity of activity compared to the traditional buffers (Ballesteros-Perez et al., 2018).

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2.3 International vs. National backdrop: Regional issues

The Indian monsoons and weather criteria in other parts of the world are significantly different (Gunduz et al., 2013). The international standards, typically those used in the UK or Turkey, tend to pay attention to such parameters as wind speed and freezing degrees (Ballesteros-Perez et al., 2018), but in the Indian case, the main factor is the level of precipitation (Doloi et al., 2012). Temperature variations on a seasonal basis are the overriding considerations in estimating the construction periods that housing projects will require in Turkey (Tirataci and Yaman, 2023). On the contrary, Indian projects are challenged with unprecedented monsoons that can provide more than 200 percent of the monthly average rainfall in a span of one week hence changing the bearing capacity of the soils and making the site access roads impassable (Iyer and Jha, 2006).

2.4 Contractual uncertainties and foreseeability gap

The difference between what a contractor should have foreseen and the level to which the event has actually taken place is one recurrent theme in the literature known as the Foreseeability Gap (Nguyen et al., 2010). According to Moselhi and El-Rayes (2002), not all construction activities are sensitive to changes in the weather, and thus it is hard to quantitatively estimate them. The causes of ambiguities tend to be highlighted by the unclear nature of the clauses in the contract which does not lay down the exact level of rainfall that would qualify to be an exceptional event (Chan and Kumaraswamy, 2002). Canadian, Malaysian and Indian studies focus on the lack of unified definitions of Force Majeure, which contributes to ongoing conflicts in climate-sensitive infrastructure development (Sambasivan and Soon, 2007; Doloi et al., 2012) and has to be addressed by predictive and data-driven arbitration schemes in the Indian context (Schuldt et al., 2021).

3.0 Research Methodology

The study is designed in qualitative and comparative format, which implies a forensic examination of 14 arbitration awards and interim project reports of the Indian infrastructure sector. It applies empirical case evidence to come up with predictive model on decision making using legal precedents and meteorological data.

3.1 Data selection

14 arbitration cases were selected purposely, and all of them were cases of climatic disputes. The sample of projects includes different projects: highways, bridges, buildings, and manufacturing facilities, which captures the difference in weather sensitivity, especially in the route and foundational projects prone to moisture.

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3.2 Analytical framework

A Multi-Factor Categorization Matrix of 12 decision factors was used to evaluate each case: It is divided into intrinsic (e.g., rainfall data, site records) and extrinsic (e.g., arbitrator perception). Results indicate that extreme weather events that are short in duration are regarded as exceptional, whereas the duration of rainfall is usually regarded as a predictable implementation risk.

3.3 Correlation and synthesis

Data on India Meteorological Department were cross-correlated with claims to isolate the predictable seasonal risks on arbitral outcomes and unusual climatic events.

3.4 Framework and validation

A Climatic Arbitration Decision Framework (CADF) was developed as a decision tree of logic to approximate the probability of a claim success depending on the severity, causation, and the quality of the documentation. To bring reliability, triangulation of evidence was applied and the separation of natural and administrative causes was made.

4.0 Data Analysis

This study is fundamentally based on a granular forensic study of 14 particular arbitration awards. Through classification of these awards, we can see that there is a convergence between the elements of technical complexity and climatic variables in order to manipulate the ultimate ruling of the tribunal.

4.1 Comparative Award Matrix (14 Cases)

The following table synthesizes the outcomes of the analysed cases, mapping the primary weather event against the final award type.

Table 1: Summary of Arbitration Awards of 14 Construction Disputes in India

Project Type	Case No.	Project Location / Name	Primary Weather Event	Core Legal Issue	Award Outcome
Highway / Road	1	Road Project, West Bengal	Extreme Monsoon	Idle machinery & fuel wastage	Partially Allowed
	2	National Highway, Odisha	Monsoon + Traffic	GSB layer damage	Full Award
	3	Rural Road Network	Unseasonal Rainfall	EoT for asphalt works	Allowed (Time Only)

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	4	Sambalpur–Rourkela Highway	1994 Extreme Monsoon	Traffic damage on GSB	Full Award
	5	NHAI Strengthening Project	Delayed Handover + Monsoon	Idle resources	Full Award
Bridge / Marine	6	Major Bridge, Pune	Dam Water Release	Dewatering costs	Rejected
	7	Bridge, Maharashtra	Regional Flooding	Loss of coffer dams	Partially Allowed
	8	Marine Bridge, Odisha Coast	Cyclone / Storm	Marine equipment damage	Partially Allowed
	9	Bridge over Perennial River, Konkan	High Water Table	Foundation redesign	Full Award
	10	Marine Bridge, Konkan	Flash Floods	Prolongation costs	Partially Allowed
Building / Industrial	11	Building Project, Delhi	Monsoon / Drainage Failure	Basement flooding	Full Award
	12	Industrial Boiler Installation, Gujarat	Cyclone	Damage to stored materials	Partially Allowed
	13	Doordarshan Bhavan, Delhi	Torrential Rain	Municipal drainage failure	Full Award
	14	Industrial Shed, Gujarat	High Winds	Structural collapse	Rejected

Source: Created by authors

4.2 Project typology breakdown of individual cases

4.2.1 Category a highway and road infrastructure

- *Case 1- Memari-Chakdighi-Tarakeswar Road, West Bengal*
  Conflict - The contractor had been asked to carry on with the roadwork during heavy monsoon rains which resulted in huge wastage of fuel (machinery idling) and wasteful labor.
  Outcome - Partially Allowed. The tribunal acknowledged that the directives by the employers to work on rainy days posed a liability of the resources that were wasted, whereas the cost of extending the duration was reduced because of poor mobilization during dry seasons.
- *Case 2 - Strengthening of Highways, Odisha*
  Conflict - Heavy rains reduced the Granular Sub-Base (GSB) into mud. The employer was insisting on having the road open to traffic and this ruined the integrity of the layer.
  Outcome - Full Award. The tribunal considered that the damage was as a direct consequence of Extraordinary Weather in conjunction with the operational mandate of the employer.

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- *Case 3 - Rural Road Network Project*
  Conflict - Unseasonal rainfall that was not within the normal monsoon period interfered with the asphalt laying exercise.
  Outcome - Allowed (Time Only). To evade Liquidated Damages, Extension of Time (EoT) was awarded, but monetary damages were not allowed since unseasonal rainfall was not considered a compensable event but an Excusable Non-Compensable event.
- *Case 4 - Sambalpur-Rourkela Highway (Package S2), Odisha*
  Conflict - This example was the monsoon of 1994 that had a rainfall of almost twice the amount of rainfall within 10 years. The main argument was whether the contractor ought to have safeguarded the GSB against road traffic or not.
  Outcome - Full Award. The tribunal granted an award of ₹11.41 lakh by approving that rainfall more than 200 percent of average is an exceptionally severe climatic condition.
- *Case 5 - NHAI Strengthening Project*
  Conflict - The employer took time to hand over the sites until very close to the monsoon. The contractor claimed that the wet hand over did not allow any earthwork to commence.
  Outcome - Full Award. The court held that when a site is offered during the commencement of monsoon transfer of the risk of idle time to the employer.

4.2.2 Category B bridge and marine works

- *Case 6 - Major Bridge at Bori in Pune*
  Conflict - Repeated discharge of water on the Yadgaon Dam caused water to become stagnant in the riverbed, affecting casting of the piers.
  Outcome - Rejected. Although the weather was the problem, the contractor could not submit the vouchers, bills or regular site records to show the actual expenditure other than what was already paid.
- Case 7 - Bridge on Naray-Bori Road, Maharashtra
  Conflict - Coffer dams were swept away by abnormal floods. The contractor was claiming reconstruction expenses.
  Outcome - Partially Allowed. Reconstruction costs were relieved, although it was cut by a third given that the contractor had not strengthened the dams to the design-build standard.
- *Case 8 - Odisha Coast Marine Bridge Case*
  Conflict - A tropical storm destroyed special marine gear and staging.
  Outcome - Partially Allowed. The tribunal had accepted the cyclone as an act of God but limited the award since the contractor had not sufficiently secured the equipment after the IMD warning.

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- *Case 9 - Bridge over Perennial River, Konkan Railway*
  Conflict -Unpredictable water table surge during monsoon created the need to alter the foundation depth, which was contrary to the initial tender.
  Outcome - Full Award. The tribunal classified the water table change as an undetermined physical occurrence in the FIDIC Clause.
- *Case 10 - Konkan Region (L&T) Flash Flood Impact*
  Conflict - Flash floods resulted in a 77 day overstay. The contractor was seeking prolonged overheads on a daily basis.
  Outcome - Partially Allowed. The court of law ruled 50% of the claim since it was known that rain is a seasonal occurrence but flash floods of that scale were not predictable.

4.2.3 Category C Building and Industrial Systems

- *Case 11 - Residential/Commercial Complex, Delhi*
  Conflict - Massive flooding of the basement due to 24 hours record rainfall.
  Outcome - Full Award. The award was given due to the fact that employer had not cleared the outside drainage channel on the site and thus changed a natural occurrence into an avoidable loss.
- *Case 12 - Installation of Industrial Boilers, Gujarat*
  Conflict - There was a cyclone that ruined the high-value welding rods and electrical cables that were stored on-site.
  Outcome - Partially Allowed. The materials award was minimized on the fact that the contractor did not utilize weather-proof sheds as the site safety policy dictated.
- *Case 13 - Doordarshan Bhavan, Central Delhi*
  Conflict - The employer did not get a municipal drainage certificate within time which complicated the torrential rain.
  Outcome - Full Award. The tribunal gave the award of ₹15 lakh with the major reason being the Administrative Inertia which led to such a huge damage caused by the weather.
- *Case 14 - Gujarat Industrial Shed Project*
  Conflict - A storm had high wind that led to the structural collapse of a shed that had been set up recently.
  Outcome - Rejected. The argument was completely rejected since the contractor had violated the provision of Insurance Compliance by letting the policy expire.

Table 2: Summary Table of the 14 Case Decision Logic

Project Type	Primary Issue	Decision Driver	Typical Result
Highway / Road	Road & GSB Damage	Traffic mandate + severe rain	Full / Partial Award

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Bridge / Marine	Water & Equipment Damage	Unforeseen physical conditions	Full / Partial Award
Building / Industrial	Site flooding & asset loss	Employer admin failure	Full Award
Any	Asset loss	No proof / insurance lapse	Rejected
Any	Equipment damage	Contributory negligence	Partial Award
Road	Scheduling	Unseasonal but mild rain	Time Only

Source: Created by authors

4.3 "Act of God" vs. Employer Fault

The results of arbitration indicate that even an Act of God defence is not always effective. In the Gujarat boiler project, the contractor was not successful in his claim because of failure to meet the requirements of insurance. On the other hand, in the Doordarshan Bhavan case, damages were paid due to the employer delays in approvals, which blocked the installation of drainage, which aggravated monsoon floods.

4.4 Data analysis statistical trends

In 14 cases, the tribunals used similar patterns, but in balancing the climatic impacts with the contractual responsibility. The victories largely relied on the cases in which weather effects were increased by actions of employers because, in most cases, such delays were caused by nature itself.

Table 3: 8 Key Factors Influencing Arbitration Awards

Factor	**Description**	**Frequency (out of 14 cases)**	**Impact on Award**
Evidence Reliability	Credibility and sufficiency of meteorological data, site records, and photographs.	14	Decisive: Claims lacking logs or IMD data consistently fail.
Climatic Severity	Whether the event was exceptional, abnormal, or beyond normal foreseeability.	14	Mandatory: Severity must be proven (e.g., ~140% above average) to qualify for relief.
Foreseeability & Mitigation	Whether the contractor could have anticipated and mitigated the weather impact.	12	Risk-Shifting: Normal monsoons are contractor risk; only abnormal events are excusable.
Contractual Compliance	Strict adherence to procedural requirements like notice periods and insurance.	11	Gatekeeper: Procedural lapses often nullify otherwise valid weather claims.

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Employer's Contribution	Whether administrative failures (e.g., late handover) exacerbated disruptions.	10	Compensatory: Employer fault often turns a non-compensable event into a compensable claim.
Entitlement to Compensation	Determining if weather impacts directly justify financial recovery.	10	Selective: Time extensions are common; monetary relief requires a higher burden of proof.
Equitable Considerations	Application of fairness to balance strict contractual bars in cases of administrative lapses.	6	Corrective: Used to ensure justice when strict contract terms lead to extreme unfairness.
Expert Testimony	Reliance on technical or meteorological experts to validate impact severity.	5	Validation: Essential for proving complex issues like unforeseen water table shifts.

Source: Created by authors

4.4.2. The probability of success of claims

A review of 14 arbitration awards shows that there is evident pecking order in the relief awarded. Tribunals in most situations would grant Extensions of Time to offer protection to the contractor against liquidated damages but refused to offer monetary compensation. The exception was that financial relief was given in cases where extraordinary weather was combined with administrative delays by employers. A total dismissal of the claims was usually associated with the low quality of evidence, no insurance coverage, or notice non-observation. On the whole, the results indicate that the relief of time is frequent, but cost recovery needs evidence that the loss was caused not by weather itself but by the employers.

4.5 Theoretical framework intrinsic and extrinsic factors

Contractual clauses are not the only factors that define weather-related disputes in Indian construction. The decision made on the case is affected by the interplay of objective project facts and the subjective opinion of arbitrators. This paper will classify these influences as intrinsic and extrinsic factors.

4.5.1 Factors intrinsic: The empirical ground

Intrinsic factors include the project level evidence that is created in the course of execution and are the foundation of any claim. Among the essential aspects, the extent of weather anomaly of the historical weather averages of IMD, the quality of contemporaneous documentation and records, including site logs and photographs, adherence to the requirements of the contractual notices, and the necessity of the necessary insurance are the ones to be mentioned. As seen during analysis of cases, even severe weather claims can fail in case documentation is not complete or insurance obligation is not fulfilled.

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4.5.2 Factors: Extrinsic, psychology of adjudication

Extrinsic factors are acting in the process of arbitration and explain the disparity of an outcome of similar climatic events. Arbitrators tend to consider sudden, high impact events to be Acts of God, whereas long term seasonal condition is normally considered as something that can be predicted. Equity is also regarded by tribunals when the employer postpones work until bad weather conditions arise and often guidelines of the experts are applied in a technically difficult situation.

4.6 Decision-making logic: Yes/No analysis

The scheme uses a hierarchical yes/no reasoning to assess assertions. Some of these factors, e.g. insurance compliance are considered to be the immediate gatekeepers, whereas the important factor in transforming time-only relief into monetary compensation is that of the employer contribution. The framework presents factual evidence with arbitral discretion by organizing these decision paths to be more reliable in predicting results.

5.0 Findings and Results

5.1 The rule of three decisive factors

In weather related construction disputes, liability is hardly ever on the basis of weather. Arbitral decisions are formed by three decisive factors, namely foreseeability, the determination whether an event was higher than the usual seasonal or historical rates, contributory conduct, especially the failure of the employer to complete site handovers, drawings, or approvals, and evidentiary proof, which demanded uniform site records, photographs, project logs, and certified IMD information. Not even harsh weather conditions can be used as an excuse to make unjustified claims.

5.2 Standard threshold of excusable delay

Arbitrators draw the line between the normal climatic adversity and extraordinary conditions. Normal bad weather may permit time recovery and not often money. The successful claims are usually events with margins way above historical standards, even almost twice the long-run rains.

5.3 Time vs. Financial relief

Abnormal monsoons usually warrant an Extension of Time (EoT) to avoid liquidated damages, but monetary compensation is awarded where breaches or delays by the employers play a role.

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5.4 Evidentiary weight

The signed hindrance registers and certified IMD data are decisive; the assumptions and post-project claims are normally not accepted. Claims require real-time documentation to be successful.

6.0 Recommendations: Climatic Arbitration Decision Framework (CADF)

6.1 Framework description

The Climatic Arbitration Decision Framework (CADF) is a four-stage logic-driven framework known to minimize subjectivity in claims of weather-related issues. It assists in differentiating normal commercial risk and compensable delay on the basis of objective and verifiable criteria.

Tier 1: Level of Severity (Meteorological Verification): Weather analysis is overlaid on 10-year IMD average. When in the range of 120% of the mean, conditions however, are considered normal risk and conditions that are above 140 percent are considered extraordinary.

Tier 2: Causation and Responsibility (Administrative Check): In case of the delays caused by employers and causing the work to fall into bad weather hours, the liability changes. In case of contractor inefficiencies that cause delays, time is the only way out.

Illustrative Case Study: On an Odisha highway project, constant rainfall and traffic ordered by the employers ruined prepared layers. The court gave ₹11.41 lakh acknowledging the measures imposed by the employers in case of weather extremes.

Tier 3: Documentation Audit (Evidentiary Check): Claims with high probability need triangulated evidence: IMD data, signed site records, and visual evidence of attack on essential activities.

Tier 4: Predictor of Outcomes (Risk Allocation): The natural events that are pure normally result in time-only relief. The effects caused by the employer on the weather conditions include relief of time and money, whereas the ordinary weather, lack of documentation, or breaches of the contract are met with denial of claims.

Illustrative Case Study: Procurement Delay on the Employer Side: The tribunal identified an implied employer duty to provide mentioned resources in Odisha project when the weather conditions caused the closure of quarry. Because alternative sourcing was needed out of the extraordinary weather and administrative limits, the extra work was to be compensable.

7.0 Implementation: Manual on contractor strategy

Individual contractors ought to use a systematic strategy manual in managing any weather- and terrain-related delays and in ensuring fair results in the Indian construction

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projects. This method is based on the methodical utilisation of weather information and professional records to measure the delays, risk management, and profitability of the project.

7.1 Pre-construction: Establishing the baseline

Contractors cannot avoid conflicts at a later stage by having no clear understanding of what good and bad weather conditions are before the start of the project. These involve introducing quantifiable weather limits, introducing realistic weather buffers into project plans on a regional basis, and negotiating contractual provisions clearly acknowledging weather and ground risks. Defined baseline can prevent the probability of a rejection of claim considerably.

7.2 Construction Phase: Mitigation and Active Monitoring

In the execution, constant oversight is important. Contractors are expected to note weather conditions on a daily basis based on the India Meteorological Department (IMD) data and directly correlate the weather conditions with the effects on the site, like flooding, waterlogging, or landslides. Weather-sensitive operations should be recorded in details site diaries, and regular checking of short-term IMD forecasts should be done to enable proactive rescheduling of weather-sensitive operations to reduce unnecessary delays to a minimum.

7.3 Claim Management: Documentation Standards

To make successful claims, they must be clear and consistent. The standardized concise forms of claims that contractors should employ should be backed by triangulated pieces of evidence, namely, official IMD data, personal site records, and visual evidence. Monthly verification with the clients should be held to assess the excusable delays and process claims on an ongoing basis and not at the end of the project.

7.4 Illustrative Case Study: Procurement Delay (Contractor Side)

A contractor wanted compensation in a project he was doing in an industrial shed in Gujarat because of bad weather, the steel and cladding had been damaged. The court dismissed the allegation because there was no required Contractor All Risk (CAR) insurance and insufficiency of storm-preparedness. The case points out that the extreme weather conditions do not even help to transfer the financial risk to the employer in the case of the contractors who neglect to maintain insurance and other basic protection measures.

7.5 Implementation guidelines

Clear climatic limits of abnormality should be set by contract (e.g., rainfall above 30 mm/day). The contractors will have to incorporate IMD data in daily logs and the weekly

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schedules. Notably, the contractors must not enter into unconditional no-loss contracts in the course of the extension requests as they in most cases restrain subsequent claims of costs.

8.0 Conclusion

This paper underscores the fact that the Indian construction industry must shift to a non-adversarial dispute resolution mechanism based on data. The assessment of 14 awards of arbitration reveals that tribunals are becoming more inclined to the more powerful documentation rather than the generic Force Majeure claims particularly where uncertainty in the environment is overlapping with administrative delays. Although time extensions are in many cases possible under the contractor, financial compensation is based on the demonstration of aggravation by employers. The suggested Climatic Arbitration Decision Framework (CADF) is a unified way of evaluating weather delays based on objective weather data, and organized documentation. By 10-20% this framework can be used to reduce delay disputes and enhance the risk allocation. With the ongoing development of India in large infrastructure programmes, the performance-based weather risks management will be needed with transparency to ensure the project resilience and sustainability of the sector.

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