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Categorization and Assessment of Combination Causes in Construction Disputes Using Analytical Hierarchy Process (AHP)

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Abstract

Construction disputes hold a position of paramount importance within the construction industry as they halt progress and incur heavy losses. Understanding the combined causes of construction disputes is crucial for effective dispute resolution and project management. For the present study, data is gathered from judicial case studies, which offer a comprehensive and objective perspective on disputes. A total of 65 cases from various State High Courts and the Supreme Court of India are collected. The objective of this study is to understand the most significant cause of dispute for which the Analytical Hierarchy Process (AHP) is employed. The process involved attributing significance to all the factors spread across 4 major categories such as (i) poor performance issues, (ii) payment issues, (iii) contractual issues, and (iv) compensation issues. Analysis was focused on frequency, effect, judgmental process, verdict and appeal of the judicial cases. The findings of this study highlight that payment issues due to contractual changes have the highest weightage of 9.6. It is followed by issues related to insufficient documentation and intermediate contractual changes. The combination of causes and hierarchy of significance contributes to a deeper understanding of the underlying causes of construction disputes. Furthermore, the critical factors that require attention are addressed while providing preventive measures.

Keywords: Payment delays; Contracts; Disputes; Construction management; Project performance; Analytical hierarchy process (AHP).
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1. Introduction

The process of building structures or infrastructure, involving planning, design, and execution is called construction. The significance of construction lies in its contribution to infrastructure development, urbanization, and the improvement of living standards globally. It is a vital industry that drives economic growth, providing employment, and meeting societal needs. Every stakeholder in the construction business has a certain amount of risk associated with their role. A possible conflict area is reached when stakeholders try to defend their interests in line with a specified clause in the agreement.[1] Due to the complexity of the construction sector and the involvement of people from numerous professions working for their gain, there is now more rivalry than cooperation and mutual advancement. Projects planned efficiently will have the roles, responsibilities and risks allocated beforehand ensuring seamless progress.[2–4] But all projects are not handled similarly and most of the projects do not have predefined roles, responsibilities and risks. Thus, whenever there is a dispute, it becomes an allegation on the other parties rather than owing up to its responsibility.[5] Among the many aspects that need to be dealt with for infrastructure development, one aspect is most often ignored which is dispute resolution. Given the repetitiveness and the time taken for resolution of the disputes using litigation (judicial process), it is essential to find alternative solutions alternatively.[6–9] For this, identification of the cause of the dispute is of utmost importance. Many causes are attributed to the manifestation of a dispute. Any issue initially emerges as a conflict and when it is not addressed, it transforms itself into a dispute. This is mainly due to the lack of awareness about the consequences of disputes. A Tunnel Boring Machine Project in Seattle, USA was one such project where various issues arose, including delays and cost overruns. One major dispute centered around changes in the construction contract related to groundwater damage caused by the tunneling process. The contractor claimed that the state transportation agency's decision to change the project's tunnel alignment increased the

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risk of groundwater intrusion, leading to additional costs and delays. This dispute resulted in prolonged negotiations and legal battles between the contractor and the state. Similarly, the Cross rail project in London, involving the construction of a new east-west railway line had major issues regarding contractual changes. Contractors raised disputes over design changes, unexpected ground conditions, and additional work requests from the client. These changes led to disputes over delays, additional costs, and responsibilities for the project's setbacks. The disputes resulted in arbitration proceedings and claims for compensation from both contractors and the client. Brazil hosted the FIFA World Cup in 2014, which involved the construction and renovation of several stadiums across the country. Construction disputes arose in various stadium projects due to changes in contractual agreements, particularly related to design changes and delays. For example, the Arena Corinthians in São Paulo faced disputes over additional works requested by FIFA, including changes to seating arrangements and security requirements. Contractors argued that these changes were not accounted for in the original contracts, leading to disagreements over costs and timelines. Similar disputes occurred in other stadium projects across Brazil, resulting in legal battles and delays in construction.

Such real-world examples give an insight into the practicality of the damage caused by disputes in construction projects. These projects due to disputes, most of them recurring in nature, have often found themselves in litigation and adjudications.[10] Contracts while being drafted require a negligible amount of ambiguity. Even in the simplest of construction projects which are straightforward in understanding and executing, detailing to the minute works has to be mentioned. Contract incomplete factors constitute some of the major causes of disputes which helps in identifying the root causes. Risk identification and assigning adequate importance to those that are potential dispute triggering causes will greatly reduce the manifestation of the dispute.[11]

Communication gaps between parties can be one of the vital reasons for disputes.[12–14] It is important to understand that not every dispute is restricted to a particular cause. It is a combination/coalition of one or more causes. Depending upon the situation and peculiarity of that particular dispute, one cause might have a slightly higher significance than the others.[15,16]

Especially concerning road construction projects like village roads, state highways, national highways, express ways, etc, key stakeholders typically include government bodies, construction companies, local communities, environmental groups, and other relevant organizations. There has to be proper understanding and communication between all these stakeholders at various levels of the project right from the inception to the closure.[17] Different stakeholders may have diverse goals, such as economic development, environmental preservation, public safety, or community well-being.[18,19] Identifying these interests is crucial to understanding coalition formation. Further, it is important to analyze the power dynamics among the stakeholders. This has to be done while considering factors such as financial resources, political influence, access to legal mechanisms, and public support.[20]

The construction process has a lot of things/people working simultaneously in their capacities and collaborating accordingly. The “4M” principle of construction management – Men, Materials, Machinery and Money, have to work in tandem for hassle free progress. It is therefore understood that any mistake of whichever magnitude in the construction process, not only affects that particular department but has repercussions over other departments as well.[21,22]

Similarly, disputes regarding a particular issue are not confined to that cause alone. There are many causes based on which disputes occur and each of these causes has immediate sub causes. Categorization of this kind helps in identifying the root cause of the dispute. It helps in understanding the exact area of wrongdoing and can be corrected, also it can be used as a precautionary measure to avoid future dispute occurrences.[23–25] For the disputes contexed with road constructions, major identified causes are non-payment, poor performance (poor quality), contractual changes and compensation. Although there are few individual sub causes that are majorly attributed to dispute in that domain. Fig. 1 is a fishbone diagram representation of the various causes and sub causes of a dispute.

The broader categorization of disputes exhibits that each category has at least four subcauses. Payment related causes have more tributaries compared to other causes. Except for compensation causes, each of the other categories has some relation with contractual changes. It is an indication that there is a commonality between all the disputes which is related to contractual clauses. Compensation though is independent in its nature; the sub causes have a significant relationship with other causes and sub causes. The general definition of compensation is to pay for the losses and it is due to the combination of other non-performing factors which led to the dispute.

Judicial cases can give an overall idea about the dispute concerning all the stakeholders, involvement, motivation and repercussions faced by them.[26] These sub causes are identified from the judicial cases concerning their significance cited by the disputed parties. As mentioned earlier, not all cases have a single cause but are a combination of many causes. But the implication of one cause over the other gives an idea to understand the importance of it. The objective of this study is to identify the significance of individual sub causes of a road construction dispute by the usage of the Analytical Hierarchy Process (AHP). Furthermore, a study is also focused on the categorization of subcauses to interrelationships among the major causes.

2. Methodology

The basis of this analysis is based on the intensive literature

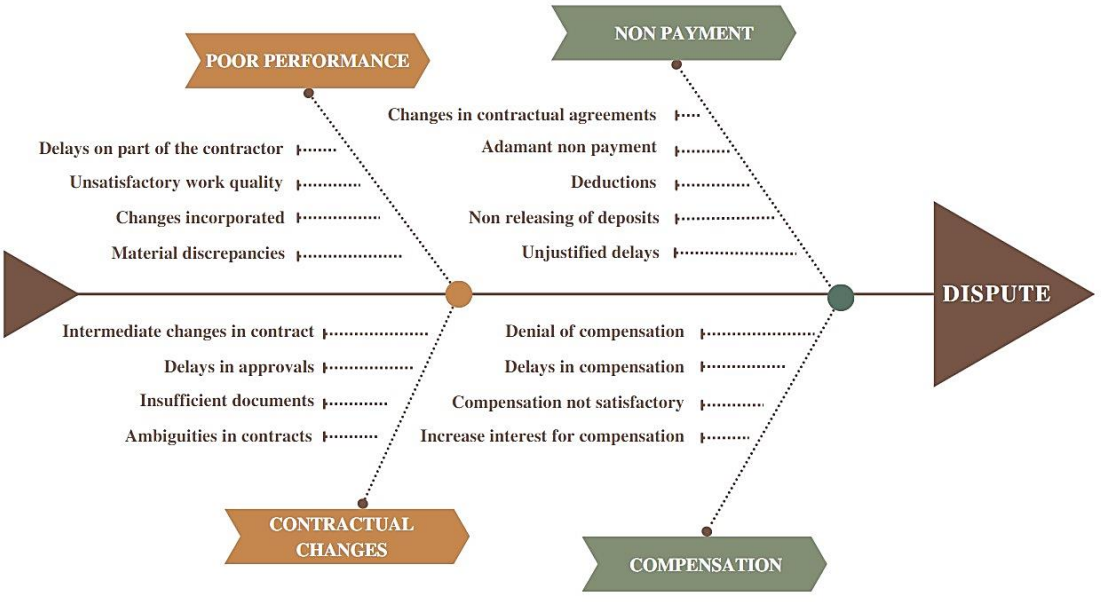

Fig. 1 Fishbone representation of causes and sub causes for road construction disputes.

studies that was carried out prior to the problem statement identification. As many as 17 factors are identified from the case studies that provoke disputes.

2.1 Data collection

Litigation cases for which judgments have been pronounced are gathered for this study. These cases are obtained from various State High Courts and the Supreme Court of India. Procuring the data from various level of courts will provide a better understanding of the dispute and also if there are any appeals on these cases, that information can also be gathered. A total of 65 cases are collected for the purpose of this study. Disputes that are categorized into four groups are also marked with respect to their sub cause. Data collected is tabulated in Table 1 to give a clear understanding of the categorization. Each of the sub causes are identified from the literature that

Table 1. Cause and sub causes of disputes with occurrences.

S. No	Causes	Sub causes	Reference	Occurrence
1	Non-Payment	Changes in contractual agreements	[27]	6
		Adamant non-payment	[28]	4
		Deductions	[29]	12
		Non releasing of deposits	[30]	4
		Unjustified delays in payment by owner	[27]	4
2	Poor Performance	Delays on part of the contractor	[31]	8
		Unsatisfactory work quality	[32]	18
		Changes incorporated apart from contractual agreements.	[33]	5
		Material discrepancies	[34]	10
3	Contractual Changes	Intermediate changes in contract	[35]	8
		Delays in approvals	[36]	10
		Insufficient documents	[37]	11
		Ambiguities in contracts	[38]	7
4	Compensation	Denial of compensation	[39]	5
		Delays in compensation	[40]	3
		Compensated amount is not satisfactory	[41]	5
		Increase interest rates for compensation	[42]	5
Total				125

match the data collected. Each of the relevant literatures are cited as references of the sub causes. The major point of argument in the litigation cases are accounted as occurrences. Some cases might have more than one cause of dispute which is the reason why occurrences are more than the collected data. It should be noted that the occurrences and repetitive nature of the causes are specific to this particular data set and can vary. Unsatisfactory work quality has the highest number of occurrences in the poor performance category, while delays in compensation has the least.

A comprehensive understanding of the data can be obtained from Fig. 2. It shows the number of repetitions of each cause and sub cause and their combinations with each other. Disputes occurring stages during various stages of the construction process is also depicted in the picture. It is to be noted that the representation is based on the data obtained for this particular study and many vary in accordance to the data collected. Out of the total 65 judicial case data obtained, only 3 instances of all the causes have been reported. Highest number of disputes are found to be during the execution stage. Next is highest is found in the planning phase. Contractual changes as well as poor performance share the maximum number of disputes. This establishes that conflicts are pertaining more to the contractual aspects and change of orders. Payments and compensations come into the picture at a later stage i.e completion or post completion phase. The contrasting difference in the numbers suggests that disputes are mostly concentrated during the initial stages. Successful completion of a project is more likely to happen when there is no dispute arousal during the planning and execution phases.
Although sub causes are mentioned for each major cause, there are influencing factors from other categories as well. Venn diagram representation in Fig. 2 gives us an idea of the combination of major causes. Whereas, Fig. 3 throws light on the influence of sub causes on other categories as well. For each cause, there is a major influence of at least one sub cause. That is considered as occurrence in that particular case. However, there is a possibility of other causes influencing that dispute as well. In an instance, the major cause is related to funds transfer. That was attributed to design changes. Thus, it is a combination of both categories. Similarly, there are other cases as well that might have even three or more common categories combined. Therefore, it is essential to consider each sub cause before finalizing the data set for analysis. It is to be noted that there are other major causes such as demolition of buildings, land acquisition and illegal occupancy etc. But these are mostly pre and post construction phase disputes according to the data collected. The focus of the present study is solely on the main four causes.

2.1 Analytical Hierarchy Process (AHP)

Since the data collection was done based on random sampling, it is difficult to arrive at the level of significance of each factor merely based on the number of repetitions. Therefore, Multi Criteria Decision Analysis (MCDA) is suggested by many researchers in which the factors are more in number.[43,44] Among the available MCDA approaches such as Multiple Influencing Factors (MIF), Analytical Hierarchy Process (AHP), Fuzzy AHP, etc AHP gives us better results as compared to others, especially in this present study scenario. Due to the presence of multiple factors, using an AHP model with an appropriate consistency check shall provide a comprehensive understanding of the significance of the factors by assigning weights to the factors accordingly. Based on these weights, a hierarchy is obtained. This analysis is not only confined to identifying the factors but also to assign appropriate significance to finally obtain the weightage of each factor using the pairwise comparison matrix.

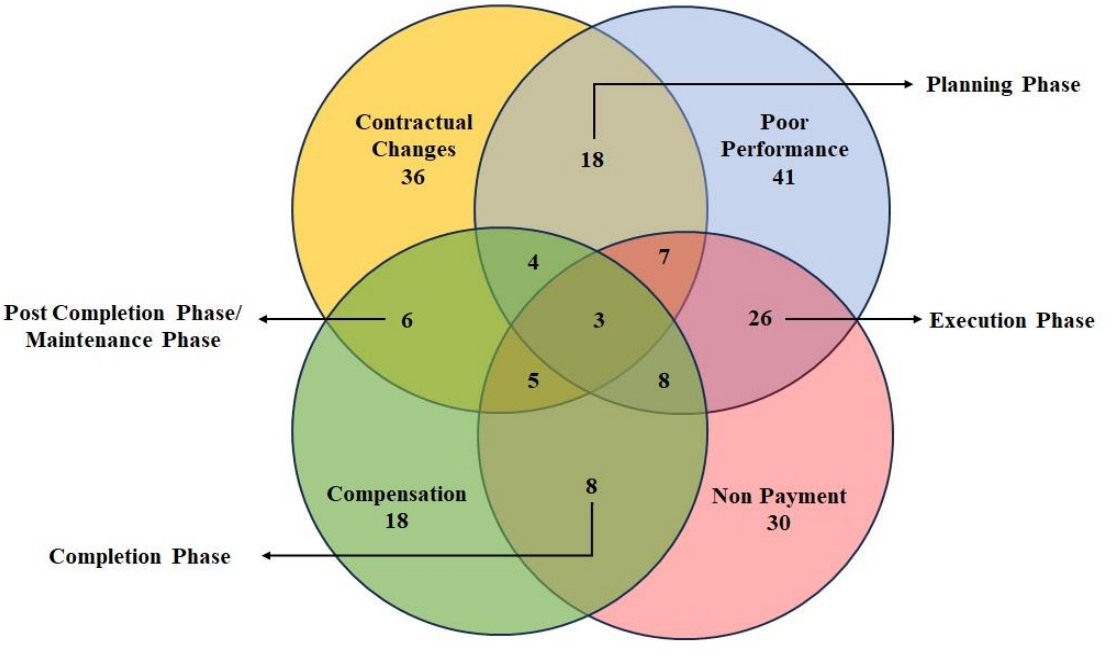

Fig. 2 Venn diagram representing common causes for road construction disputes.

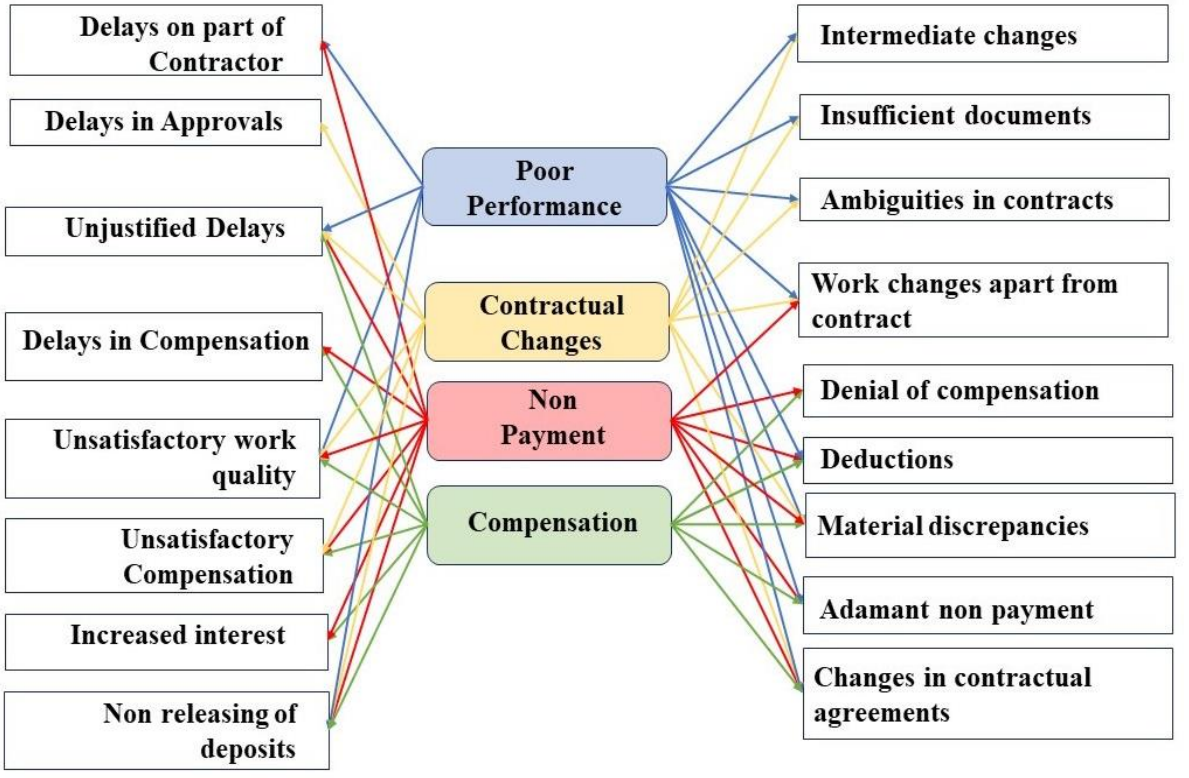

Fig. 3 Interrelationship between causes for road construction disputes.

To develop a consistent model, the factors need to be confined to a maximum number of 15 factors. Therefore, the obtained 17 factors are condensed to 15 while combining two factors from the categories of poor performance and compensation into one (changes incorporated apart from contractual agreements and compensated amount not satisfactory). Furthermore, a pairwise matrix is plotted with relative significance levels attributed to each factor on a fundamental scale ranging from 1/4 to 4. Fractional values 1/4, 1/3, and 1/2 imply less significance in descending order. Similarly, values 2, 3 and 4 imply significance in ascending order. While 1 implies equally significant to each other.[45]

The first step is to define the hierarchy of factors. In this case, by having 15 dispute causing factors in the construction industry, the hierarchy could be structured in two levels. Level 1 is dispute causing factors and level 2 is 15 specific factors such as changes in contractual clauses, insufficient documents, no releasing of deposits, etc. The next step is to construct the Pairwise Comparison. If A has more importance compared to B, depending on the level of significance it has a natural value. In a vice versa scenario, a fractional value is assigned based on the importance level. This process is done based on Saaty's rank and significance scale. Which is an indication of the hierarchical order of inputs. It is shown in Table 2. The factors as mentioned above are confined to two 15 by combining two of them. Each one is attributed with an alphabet for ease of understanding.

Figure 4 is a representation of the process used to derive the weighted averages for each of the sub causes. The criteria for assigning the weightage are based on the factors as mentioned in the figure. As the data collected is from judicial cases, ranks are based on the frequency or the repetitive nature of the type of dispute. As most of the disputes are a combination of one or more causes, it is important to analyse the effect of one cause over the other. Depending on the major point of argument regarding the dispute and the other factors which result in developing into another cause, the effect is considered and rank is assigned accordingly. Judgemental process considers the petitions on which the case is filed, the evidences the parties provide to prove their point of argument as well as the citation of previous judgments used to provide judgement to the present case. Combining all these aspects, ranks are assigned to the subcauses. Similarly, the verdict of the judgement, seriousness of the case as well as the time taken to provide the judgement is considered as it impacts the merit of the case. Some cases take unusually long time to provide a clear judgment while some are straightforwardly cleared. This aspect is also considered while assigning the ranks. Finally, reappeal by the losing party is also taken into account. Reappeal is the opportunity taken by the losing party to try to revise the judgement in their favour. While not all cases are considered for reappeal and not all the reappealed cases are revised, it is important to know the factors on which the party has applied for the same. If there are any important aspects to be considered, they are taken into account. Saaty's rank and significance scale is an indication of the hierarchical order of inputs. It is shown in Table 2. The factors as mentioned above are attributed with an alphabet for ease of understanding.

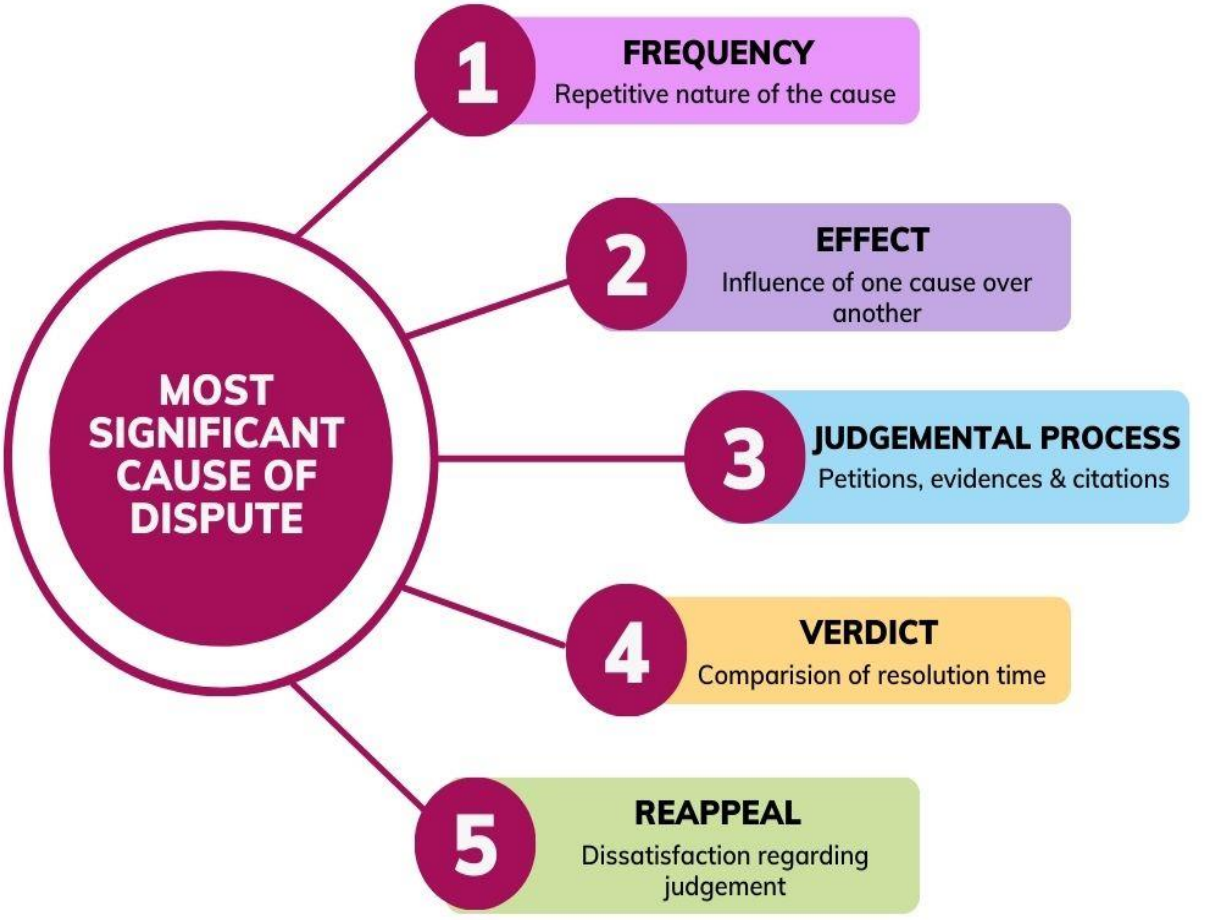

Fig. 4 Factors for assigning weights to the most significant cause of dispute.

Table 2. Pairwise Comparison Matrix of 15 parameters.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
A	1.00	3.00	2.00	3.00	0.50	1.00	2.00	2.00	1.00	1.00	1.00	2.00	2.00	2.00	2.00
B	0.33	1.00	0.50	1.00	1.00	2.00	1.00	2.00	1.00	1.00	0.33	2.00	1.00	1.00	1.00
C	0.50	2.00	1.00	1.00	0.50	2.00	0.50	0.50	2.00	2.00	0.50	0.50	0.33	1.00	2.00
D	0.33	1.00	1.00	1.00	1.00	0.50	2.00	2.00	0.50	3.00	0.50	0.50	1.00	2.00	2.00
E	2.00	1.00	2.00	1.00	1.00	0.50	2.00	0.50	0.50	1.00	0.50	0.50	2.00	0.50	0.50
F	1.00	0.50	0.50	2.00	2.00	1.00	1.00	0.50	0.50	1.00	0.50	0.50	1.00	2.00	4.00
G	0.50	1.00	2.00	0.50	0.50	1.00	1.00	4.00	0.50	0.50	0.50	0.50	0.50	0.50	0.50
H	0.50	0.50	2.00	0.50	2.00	2.00	0.25	1.00	1.00	2.00	0.50	1.00	0.50	2.00	0.50
I	1.00	1.00	0.50	2.00	2.00	2.00	2.00	1.00	1.00	0.50	0.50	2.00	2.00	2.00	2.00
J	1.00	1.00	0.50	0.33	1.00	1.00	2.00	0.50	2.00	1.00	0.50	2.00	2.00	0.50	0.50
K	1.00	3.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	1.00	1.00	0.33	2.00	0.50
L	0.50	0.50	2.00	2.00	2.00	2.00	2.00	1.00	0.50	0.50	1.00	1.00	0.50	2.00	0.50
M	0.50	1.00	3.00	1.00	0.50	1.00	2.00	2.00	0.50	0.50	3.00	2.00	1.00	1.00	1.00
N	0.50	1.00	1.00	0.50	2.00	0.50	2.00	0.50	0.50	2.00	0.50	0.50	1.00	1.00	1.00
O	0.50	1.00	0.50	0.50	2.00	0.25	2.00	2.00	0.50	2.00	2.00	2.00	1.00	1.00	1.00

* (A - Changes in contractual agreements; B- Adamant non payment; C- Deductions; D- Non releasing of deposits; E- Unjustified delays for payment by owner; F- Delays on part of contractor; G- Unsatisfactory work quality; H- Material discrepancies; I- Intermediate changes in contract; J- Delays in approvals; K- Insufficient documents; L- Ambiguities in contracts; M- Denial of compensation; N- Delays in compensation; O- Increase interest rates for compensation)

The principal eigenvector in AHP and the index of consistency approach help derive and nullify the uncertainty in the factors. It is important to check the consistency as it can be possible to assign contradictory comparative values for the factors. This might happen due to the lack of clarity in assigning relative importance to the values. Consistency Ratio (CR) is represented in equation 1 which defines the value of probability. It is used to develop the matrix.

$$Consistency\ Ratio\ (CR) = \frac{Consistency\ Index\ (CI)}{Arbitrary\ (AI)} < 0.1 \quad (1)$$

$$Consistency\ Index\ (CI) = \frac{\lambda \max - n}{n-1} < 0.1 \quad (2)$$

The obtained pairwise matrix is said to be consistent if the attained Consistency Ratio (CR) is less than or equal to 0.1. The CR is calculated by dividing the Consistency Index (CI) and Arbitrary Index (AI) represented in Eq. 1. In this study, the obtained CR is 0.096. 'n' is the factor count, and λmax is the result of dividing the weighted sum values by the criterion weight is shown Eq. 2. The arbitrary index varies depending on the number of factors considered for the pairwise matrix. The 'n' input parameter is 15 and the corresponding AI randomly generated are represented in Table 3.

Table 3. Arbitrary Index for 15 parameters.

n	AI
1	0
2	0
3	0.58
4	0.9
5	1.12
6	1.24
7	1.32
8	1.41
9	1.45
10	1.51
11	1.52
12	1.54
13	1.56
14	1.58
15	1.59

Weighted sum values for the matrix are produced by adding the scale of relative importance to the standardized weights and summing each value in a row. The obtained CR values for the various layers and the classes that correspond to them fall within the allowable range, demonstrating the consistency of the pairwise consistency matrix. The significance is assigned based on the question of the importance of each factor on another. Depending on the weightage each factor received during the court proceeding the weightage is assigned. The first consideration was on what major cause the case is filed and what are the contributing sub causes to it. Subsequent consideration is the judgment given. Significance seen in the judgment on a particular sub cause to a dispute category is considered. In some cases, consideration changes according to the peculiarity of the case.

Thus, the process of assigning weights to the causes can be carried forward. Next is to calculate the weighted score. The values obtained after the pairwise comparison, are used in calculating the weighted scores for each of the disputed factors, in this case, 15 of them. Summing up the row values and dividing by the total number of factors compared, the weights for each factor can be achieved.

3. Results and discussions

From the analysis done to find out the most significant cause of dispute based on the weighted averages attributed to each cause as shown in Table 4, it is to be understood changes in contractual agreement are the most significant.

Table 4. Normalized weights for disputed causes.

Causes	Weights
Changes in contractual agreements (A)	9.60
Insufficient documents (K)	9.20
Intermediate changes in contract (I)	8.00
Denial of compensation (M)	7.00
Increase interest rates for compensation (O)	6.90
Non releasing of deposits (D)	6.60
Deductions (C)	6.50
Material discrepancies (H)	6.50
Ambiguities in contracts (L)	6.50
Delays in approvals (J)	6.10
Adamant non payment (B)	6.00
Unjustified delays for payment by owner (E)	6.00
Delays on part of contractor (F)	6.00
Delays in compensation (N)	5.20
Unsatisfactory work quality (G)	3.90
	100.00

3.1 General discussion

Figure 5 is an illustration of the hierarchy of the causes of disputes concerning the obtained weighted averages. Except for the first four causes according to the weighted averages, *i.e.*, changes in contractual agreements, insufficient documents, intermediate changes in contracts and denial of compensation, other causes have similar significance as they have more or less confined values in the range of 6 to 7. Especially, deductions, material discrepancies and ambiguities in the contract have the same weighted averages with equal significance with a value of 6.50. Similarly, unjustified delays for payment by the owner, adamant non-payments and delays on part of the contractor have the same significance with a weighted average value of 6.00. Finally, delays in compensation and unsatisfactory work quality occupy the last spots in weights with values of 5.20 and 3.90 respectively. On the whole, disputes due to payment issues have a combine weighted average of 34.7. Poor work performance resulting in disputes have an average of 24.4 with all the cub causes combine. Compensation issues relating to disputes have a consolidated weighted average of 25.4. It is to be noted that one sub cause (compensated amount not satisfactory) was

clubbed into increased interest rates for compensation. Therefore, value for that particular sub cause is obtained by taking the mean of other three causes and adding it to the final score. Finally, disputes due to contractual changes have obtained a combined weighted average value of 29.06. Similar to compensation issues, contractual changes also had one of the sub causes clubbed into one (changes incorporated apart from contractual agreements). The final value obtained is through the same process adopted for compensation cause. It is to be noted that these values and weights assigned are with respect to the data collected and analysed pertaining to this study. There are chances that these values might vary for different data sets. Validation of this study is proved by the consistency checks done in the AHP modelling which ascertains the analysis being correct.

3.2 Non-Payments

Non-payment category was recorded to be almost 15% of the cases obtained in the case studies. Although other categories have higher numbers, it is important to consider this as it is a recurring one as the significance is more with a combined weighted average of 34.7. A problem identified in any other category based on some factors can be identified, analyzed and rectified, but this is a dangerous case as the problem itself is not defined properly to obtain a solution for the same. It is to be understood that only when the dispute is put forth in front of the court of law or in the presence of mediators/arbitrators is the reason for non-payment spelled out to a certain level. Studies suggest that disputes in this category are on the rise, especially in India.

Also in some cases, the security deposits given by the contractor as part of the contract are not released punctually and this is a serious issue. It does not only mean that money is put on hold but the reputation of the contractor is at stake as well. This is because the security deposit is held up in such a situation where the work executed is not as per the standards specified. It leaves a bad remark on part of the contractor as the profile gets damaged whether or not the accusation is a truthful one.

Apart from all the scenarios, payments are held up for no reason at all. These can be attributed to the adamant non-payment category and unjustified delays. Despite repeated requested and demands from the contractors, the payments are not made on time. This is especially true while handling government projects. It is to be noted that Public Private Partnership (PPP) projects and their contractual clauses are entirely different which mostly involve capital recovery throughout the maintenance period. But in other small scale projects such as road developments in state government jurisdiction, the contract is a straight forward one. Due to these discrepancies, payments are put on hold and it affects the stakeholders as well as the project in many ways.

3.3 Poor performance

The consequences of disputes on contractors are usually attributed to the owners. It is not always true that conflict or disputes happen only due to the owner. Rather it is the other way around with almost 60 percent of the cases identified in this study having issues that are due to the contractor. The mistakes that the contractor makes during the process of execution of the project are mostly responsible for the consequences that need to be faced after the project's completion. It is to be understood that the causes are mostly interrelated to each other. When the completed work does not meet the required standards or specifications outlined in the contract, disputes have occurred regarding rectification, costs, and responsibility for the deficiencies. Disputes may arise when there are inconsistencies or conflicts between different contract documents, such as the drawings, specifications, and general conditions. Resolving these discrepancies can become a point of contention. Out of the causes found to be categorized by performance issues, it was often found to be interrelated with payment issues. Instances of delays in payments led to delays in procurement of materials etc. The quality of construction which depends on timely progress was left idle due to lack of funds. Scenarios in which less amounts were dispensed, quality was compromised. Payment of timely wages to the labour affected the quality as some works require adequate and appropriate time. These kinds of works got disrupted to labour un interest due to payment issues.

3.4 Compensation

Disputes may arise when a party denies compensation for valid claims, leading to disagreements over the amount or entitlement to additional payments. If compensation is delayed, contractual provisions may allow for the charging of interest on overdue amounts. Disagreements occurred over the calculation or reasonableness of the interest rates. If the contractor is not paid promptly or as agreed, their performance may be impacted, leading to delays in work or a decline in productivity. Compensation issues can stem from both payment and poor performance issues. Disputes over the adequacy of compensation can relate to delays in payment or unsatisfactory work quality, further exacerbating the overall conflict.

Exculpatory clauses are incorporated into building contracts to stop contractors from making certain damage compensation claims. Common law principles state that a person who suffers damage or loss as a result of another party breaking obligations has a right to compensation. However, exculpatory clauses are frequently found in construction contracts, which normally prevent the party affected by the violation from claiming damage expenses and limit compensation to merely a time extension. Payment disputes can also occur when there are delays in completing the project. The contract might include provisions for liquidated damages in case of delays, and the contractor may dispute the assessment of these damages.

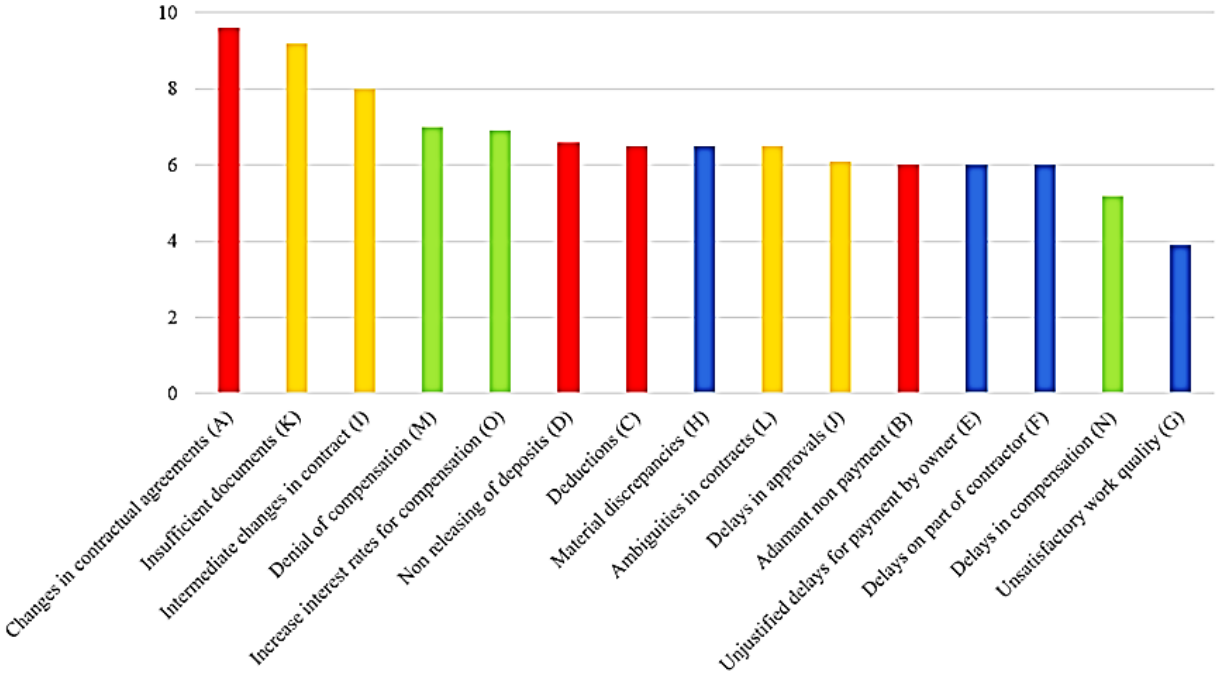

Fig. 5 Hierarchy of the causes of disputes.

3.5 Contractual changes

Contractual changes category has a combined weightage of 29.80. Insufficient documents have obtained a weightage of 9.20 making it the second most common cause of dispute, just behind changes in contractual documents sub cause from the poor performance category. It needs to be observed that irrespective of the major category, issues related to contract documents have secured the top-level hierarchy which indicates significance of the issue. As compared to other sub causes and major categories, fiddling the contractual clauses or ambiguity in the contracts have been the centre point of conflict. When there are changes or modifications made to the original contract terms and conditions, disagreements can occur regarding the impact of these changes on payment obligations. Failure to address changes adequately in the contract can lead to disputes. Incomplete or inadequate documentation have resulted in misunderstandings or disagreements regarding payment milestones, quantities, or pricing. Lack of clarity in documentation can give rise to payment disputes. Delays in obtaining necessary approvals or permits from authorities can impact project timelines and potentially result in financial losses or claims. Disagreements may occur regarding responsibility for these delays. Apart from these, ambiguities in contracts are one of the major flaws. It is necessary to give the exact specification and detailing of the materials and machinery to be used as well as the time frame within which the work needs to be executed. Vague and unclear instruction often leads to work in sub-standard levels. It is not only the responsibility of the owner to give exact and complete information but also the responsibility of the contractor to clarify the missing information in the contract prior to the work execution stage. It is also gives an image of being careless on part of the contractor and could be acting as a hindrance in the future tender allocations.

The relationship between contractual changes and payment issues becomes evident when there are modifications to the original contract. As changes are made to the scope or specifications of the project, the contract price and payment terms may need adjustment to reflect the new circumstances accurately. Failure to address these changes properly can lead to payment disputes. Additionally, if there are disagreements between the parties about the validity of change orders or the impact of modifications on the project's cost and schedule, payment issues can escalate, resulting in formal claims, mediation, or even litigation.

It has become a common practice that once the agreement is signed and the project is in the execution stage, a number of changes happen to the prior agreed contract. This is due to several reasons that include budget changes, time constraints, etc. But the problem is that the dispute arises when these changes happen without the consent of either of the parties. During every phase of the execution process, certain changes to the existing plan or process might take place, which is natural for most projects. Sometimes it even adds value to the project. But the changes made without the stakeholder's knowledge, even those which are beneficial for the project might not be accepted. It narrows down to a communication gap that has to be bridged between the partners, often, the initiative taken for the same is lacking. A separate clause in the contract is aspired by many people in the industry which states that no additional changes to the agreed contract can be made without mutual consent and if done it is liable to be legally charged.

Some of the best practices to proactively manage or

address issues related to contractual changes with respect to the study findings are:

- Establish clear documentation protocols to mitigate insufficient documents issues.
- Regularly review and update contractual clauses to minimize ambiguity.
- Implement robust communication channels to address contract-related concerns promptly.
- Conduct thorough contract reviews with involved parties to ensure mutual understanding.
- Provide ongoing training on contract interpretation and negotiation skills.
- Utilize technology for document management and tracking changes.
- Develop a culture of transparency and collaboration among stakeholders involved in contract management
- Seek legal counsel when necessary to resolve complex contractual issues promptly.

To manage the relationship between poor performance, contractual changes, payment and compensation issues effectively, clear communication and documentation are crucial. All parties should carefully record all changes, maintain accurate records of work performed, and follow the contract's established procedures for processing change orders and payments. Resolving disputes in an amicable and timely manner is essential to keep the project on track and prevent escalation of conflicts that can lead to costly delays and legal actions. Alternative dispute resolution techniques incorporating in each phase of construction may help not only in reducing the time taken to resolve disputes but also acts as a check on dispute arousals at various phases. Future studies in this area might provide a better solution and understanding for this problem.

3.6 Policy-making and industry practices

Understanding the significance of alterations in contractual agreements is pivotal for informing policy-making and shaping industry practices across various domains. Primarily, it highlights the criticality of crafting precise and exhaustive contracts with detailed specifications to mitigate ambiguity and prevent potential disputes. Clarity in contractual language not only establishes a common understanding but also serves as a blueprint for executing obligations. Secondly, it underscores the necessity of implementing robust change management protocols to expertly navigate modifications with efficiency and transparency. Such procedures are instrumental in facilitating smooth transitions, ensuring compliance, and preserving the integrity of contractual obligations. Thirdly, it underscores the imperative for proactive communication and collaboration among stakeholders to promptly address alterations and minimize their repercussions on project timelines and expenditures. In essence, comprehending the prominence of changes in contractual agreements is of paramount importance for fostering effective governance, enhancing operational efficacy, and promoting sustainable business practices.

3.7 Limitations of present study

The study's limitations are primarily from the small dataset of 65 cases and the lack of establishment of intricate relationships among subcauses. With such a limited dataset, the findings may not accurately represent the full spectrum of road contract disputes, potentially leading to biased conclusions. Absence of a clear representation of sub cause relationships within the identified categories hampers the depth of understanding regarding interactions among disputes. The study's findings may not provide a comprehensive understanding of the complex nature of road contract disputes, limiting the applicability of its recommendations. For mitigating conflicts and improving contractual terms and payment processes in the construction industry, further research with a larger and more diverse dataset is required. It is to be combined with a more detailed analysis of sub cause relationships, to address these limitations and enhance the study's validity and relevance.

3.8 Future Scope for dispute mitigation studies

Future studies in the domain of construction dispute mitigation could benefit from expanding the dataset for a broader range of cases, thereby providing a more comprehensive understanding of dispute causation factors. Incorporating methodologies beyond Analytic Hierarchy Process (AHP), such as Analytic Network Process (ANP), TOPSIS, VIKOR, and Fuzzy Logic, would enrich the analysis and offer diverse perspectives for decision-making. Moreover, integrating judicial datasets into research would offer unique insights into dispute resolution dynamics. A multidimensional approach that combines diverse datasets with various analytical methodologies could enhance the effectiveness of dispute mitigation strategies in the construction industry, ultimately leading to more informed and proactive decision-making processes.

4. Conclusions

In conclusion, this study utilized Analytical Hierarchy Process (AHP) to categorize and assess combination causes in construction disputes based on data from 65 judicial cases in India. Data is collected through a random sampling method. Significance of a causes is not conveyed through the number of repetitions. Thus, using the Multi Criteria Decision Analysis (MCDA), Analytical Hierarchy Process (AHP) is incorporated. The AHP process involved attributing significance to factors across four major categories. The objective was to identify the most significant cause of disputes and the hierarchical significance provides a deeper understanding of construction disputes.

The study highlights those contractual changes, with a significance of 9.6, play a pivotal role in disputes. Issues related to payment, insufficient documentation, and intermediate contractual changes also contribute significantly, with cumulative weightages of 34.7, 24.4, and 25.4,

respectively. This hierarchy of significance offers valuable insights for stakeholders in the construction industry, enabling them to address critical factors and implement preventive measures. It is important to note that the study has some limitations, such as the confined dataset of 65 cases and the potential for a more extensive and diverse dataset for in-depth analysis. While AHP is an effective decision-making tool, the study suggests that incorporating judicial data could provide a unique perspective for analysis. Industry practices such as clarity in contractual language as well as implementing management protocols to facilitate modifications will greatly enhance dispute mitigation. Overall, understanding the interrelations of individual issues and their significance aids in mitigating conflicts and improving contractual terms and payment processes to reduce the likelihood of construction disputes.

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Conflict of Interest

There is no conflict of interest.

Supporting Information

Not applicable.

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