

## The Application of Sichuan and Chongqing Regional Cultural Identity Factors in the Appearance Design of Subway Trains

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### ABSTRACT

The regional culture of Sichuan and Chongqing in China is deeply rooted in history, yet its integration into contemporary urban rail train design remains underdeveloped. While contributing to academic discourse, existing research has not effectively addressed the homogenization of subway design, which often lacks cultural depth and regional distinction. This study explores the constituent elements, current status, and challenges of incorporating regional cultural identity into the design of urban rail trains in Sichuan and Chongqing. Using a mixed-methods approach—including literature review, quantitative analysis through surveys and statistical methods, and qualitative research employing deconstruction, reconstruction, and the Analytic Hierarchy Process (AHP)—this study constructs an evaluation model to assess the influence level of regional cultural factors. These factors are integrated into subway train design by systematically identifying and optimizing high-impact cultural elements to enhance cultural heritage and establish a strong regional identity. The design framework is structured around a symbolic system that aligns with public perception, aesthetic preferences, and cultural recognition, ensuring a balance between modern and traditional elements. Sichuan and Chongqing's unique patterns, cultural motifs, and design elements are synthesized into a cohesive train design, reinforcing cultural identity and aesthetic value. This research provides theoretical and practical guidance for the future development of urban rail transport design and contributes to the broader goal of promoting Chinese cultural confidence. Furthermore, it offers valuable insights for internationalizing China's high-end equipment manufacturing, particularly in the Belt and Road Initiative and ASEAN-related projects.

**Key words:** Urban Rail Transit, Regional Culture, Cultural Identity Factors, Subway Trains Design, Application, Cultural Literacy

### INTRODUCTION

The Sichuan-Chongqing region, an essential cultural and economic hub in southwest China, possesses a distinctive geographical location, profound cultural heritage, and abundant cultural resources. Its cultural characteristics and values provide significant inspiration for the design of rail transit trains, reflecting both traditional and modern urban elements. The culture of Sichuan and Chongqing is profoundly shaped by its geographical environment, historical evolution, and diverse ethnic composition, leading to unique cultural attributes such as vibrant folk art, distinctive culinary traditions, and the fusion of multiple ethnic influences (Zhang, 2018). Sichuan-Chongqing folk culture is characterized by its vibrancy and bright colors, which can be effectively integrated into design elements such as color schemes and structural forms to enhance regional identity and visual recognition (Xiang, 2019). Over time, the region has accumulated a rich tapestry of historical relics, cultural traditions, social customs, and distinctive lifestyles, forming a multidimensional

cultural structure. These cultural elements can be translated into diverse design languages and styles, allowing urban rail design to cater to different passenger groups' aesthetic preferences, cultural expectations and literacy (Lin, 2007).

Building on the constituent elements and their weighted relationships within the regional cultural framework of Sichuan and Chongqing, this study focuses on the symbolic patterns unique to the region (Li & Zhang, 2020). It systematically organizes classic Sichuan-Chongqing pattern symbols and constructs a metro train design symbol system through an interdisciplinary approach. This research develops a structured design methodology that aligns visual aesthetics with cultural semantics by integrating the "invariant moment and geometric features" pattern recognition algorithm with Roland Barthes' semiotic theory (Huang, 2020). This approach effectively incorporates regional cultural identity into metro train design, ensuring that the final design embodies both traditional cultural heritage, cultural literacy and contemporary design innovation.

## Research Objective

This research aims to integrate the regional cultural identity of Sichuan and Chongqing into urban rail train design by addressing the lack of cultural depth and regional distinction. Using a mixed-methods approach, including the Analytic Hierarchy Process (AHP), it constructs an evaluation model to identify and optimize key cultural elements. The study enhances cultural identity and aesthetic value in train design by developing a symbolic design framework that balances tradition and modernity. Additionally, it provides theoretical and practical guidance for future applications while supporting the internationalization of China's high-end equipment manufacturing in the Belt and Road Initiative and ASEAN projects.

## LITERATURE REVIEW

Early research on the intersection of cultural identity and design largely remained theoretical, lacking systematic empirical studies and specific design case analyses. For instance, while Huang (2020) explores cultural identity in design, her work does not provide detailed practical guidance on effectively integrating cultural identity into rail transit train design. Additionally, research on the cultural identity of the Sichuan-Chongqing region remains insufficient, particularly regarding its application in modern vehicle design. Despite in-depth discussions on Sichuan-Chongqing folklore (Chen & Li, 2022), there is a notable gap in research on transforming these cultural elements into practical design applications, leading to a disconnect between theoretical discourse and design implementation (He & Wu, 2021).

Moreover, while domestic and international studies on cultural identity in design have made some progress, most focus on the preservation and display of traditional culture (Wang, 2018), with limited research on the dynamic evolution of Chinese cultural identity amid modern urbanization. The predominant focus has been on extracting and applying static cultural symbols without adequate attention to the fluidity of cultural identity in rapidly changing social contexts (Zhang, 2018). Another critical limitation is the lack of interdisciplinary research. Studying cultural identity necessitates collaboration across cultural studies, sociology, and design disciplines. However, much-existing research remains constrained within single-disciplinary perspectives, failing to integrate diverse theoretical frameworks and methodologies. This lack of interdisciplinary integration limits both the applicability and breadth of research findings (Wang & Liu, 2021). Addressing these limitations requires a more comprehensive approach that bridges theory and practice, incorporates dynamic cultural changes, and fosters interdisciplinary collaboration to develop a robust framework for integrating cultural identity and literacy into contemporary design.

## RESEARCH METHODS

This study employs a mixed-methods approach, integrating qualitative and quantitative evaluation methods to

systematically optimize regional cultural factors in the design of Sichuan-Chongqing urban rail trains. The research follows a structured process based on the Analytic Hierarchy Process (AHP) to assess and optimize cultural identity elements, ensuring their effective integration into train design.

## Importance Assessment Methods

The assessment methods used in this study are classified into qualitative and quantitative approaches. Qualitative evaluation relies on subjective judgment through observation, analysis, and induction, while quantitative methods utilize mathematical models to derive objective conclusions through weight index calculations. These include the Analytic Hierarchy Process (AHP), Principal Component Analysis, Fuzzy Comprehensive Evaluation, Entropy Weight Method, and Neural Network Evaluation (Xu et al., 2014). Among them, AHP is particularly suitable for multi-criteria decision-making in design, balancing qualitative and quantitative assessments. Given its effectiveness in determining weight coefficients and selecting conceptual elements (Ding et al., 2021), AHP is adopted in this study as the primary evaluation method. A structured questionnaire survey was conducted to collect empirical data, which was statistically analyzed to determine key cultural factors and their relative importance.

## Analytical Hierarchy Process

The optimization process of regional cultural identity factors using AHP follows a five-step framework:

1. Cultural identification: Defining the regional scope and conducting cultural research to identify and select typical regional cultural carriers.
2. Factor extraction: Extracting cultural modeling factors, color elements, and connotation aspects from selected cultural carriers to establish a comprehensive dataset.
3. Questionnaire survey: Designing and distributing structured questionnaires to target respondents, then statistical analysis of the collected data to obtain quantitative evaluation indicators and values.
4. Factor optimization: Construct a hierarchical evaluation model comprising target, criterion, and indicator layers. Conduct pairwise comparisons to form a judgment matrix and calculate weight coefficients. A consistency test ensures the reliability of results, leading to a systematic ranking and optimization of regional cultural factors.
5. Application evaluation: Applying the optimized cultural factors to train appearance design, including form, exterior painting, and symbolic connotation. The final design proposal is assessed within train design constraints (Xu, 2014), and cultural identity validation is conducted through subjective evaluations from potential users to ensure accuracy and practical feasibility.

This methodological framework ensures a scientifically grounded approach to integrating regional cultural identity into urban rail train design, bridging the gap between cultural heritage and modern transportation aesthetics.

## RESULTS

### Current Status and Challenges of Appearance Design of Urban Rail Trains in Sichuan and Chongqing

In Sichuan and Chongqing, urban rail transit construction is a unique topic. First of all, the rich and diverse cultural needs of the Sichuan-Chongqing region must better reflect the regional characteristics in the design. However, the current use of traditional elements in the design is still relatively superficial, and the profound connotation of the Sichuan-Chongqing culture cannot be deeply excavated and expressed. Secondly, the current train shape design mainly focuses on function and economy while ignoring the integration of cultural elements, resulting in a lack of regional identification and cultural charm. Therefore, integrating regional culture into it to ensure advanced technology and efficient operation is an urgent problem that needs to be solved. Today, with the increasing aesthetic awareness of the public, passengers have higher and higher requirements for the cultural connotation and aesthetic requirements of the shape design of urban rail trains (Zhang & Yang, 2020). In order to solve the above problems, designers must find a new balance between technology and culture and improve their cultural expression and literacy with innovative design ideas and methods. At the same time, the government and the design unit should strengthen cooperation, integrate cultural elements into the architectural design, and jointly build a rail transit system with the characteristics of Sichuan and Chongqing (Sun & Li, 2022).

### Design Application Cases

Based on the above research findings, the optimization strategy and specific application of relevant cultural factors in the design of the Sichuan-Chongqing (Chengdu Line 5) subway train are further elaborated on, taking the design of the Sichuan-Chongqing (Chengdu Line 5) subway train as an example.

### Optimizing cultural elements

In terms of the exterior design of the subway train, under the premise of fully considering the issues that can not only represent the image characteristics of Sichuan and Chongqing but also have high affinity and popularity, the Sichuan and Chongqing cultural modeling factor prefers the Sichuan-Chongqing face shape X3 under the natural ecological modeling C1, that is, the extraction of Sichuan and Chongqing face lines and colors is used as the appearance and modeling cultural elements of Chengdu metro trains. Regarding subway train appearance design, Cultural color factors are more inclined to the natural color C5, and the appearance color of characters/animals/plants under C5 X15, that is, the color of the character's face and body. Moreover, the traditional architectural color X16 under the historical heritage color C6 is the purple exclusive to the Sichuan-Chongqing (Chengdu Line 5) subway. In terms of the cultural connotation of the subway train, the cultural connotation factor of Sichuan and Chongqing optimizes the form of historical relics to extract

the form element X5 of the historical relics under C2, adopts the traditional face image of Sichuan and Chongqing, shows the beauty of the fusion of classical and modern in Sichuan and Chongqing, and the appearance of the subway train adopts a large curve and rounded design style.

### Sichuan-Chongqing (Chengdu Line 5) subway train exterior design

The core shape of the train design is derived from the head profile and cultural relics of the Sichuan and Chongqing masks: through modeling lines and color contrast, the eyes and ears of the Sichuan and Chongqing masks are abstracted into the local shapes of the headlights and roof respectively; the exterior paint is mainly the purple color of the Sichuan and Chongqing masks, supplemented by The yellow finish enhances the appearance of the subway train (Chengdu Line 5); in addition, in order to further display the cultural elements of Sichuan and Chongqing cultural relics, the abstract pattern of the cultural relics' portraits is also integrated into the side door of each room. Figure 1 is the application rendering of the design plan and related cultural elements. The application uses "Traditional Masks of Sichuan and Chongqing" as the theme to highlight the regional culture of Sichuan and Chongqing.

### Cultural evaluation of design solutions

1) Evaluation by industry experts. Before bidding for the design scheme of the Sichuan-Chongqing (Chengdu Line 5) subway train, the expert team of "Southwest Jiaotong University + CRRC Group" (one of the author's representatives of the designers of "CRRC Group" participated in the design) was demonstrated, and the scheme was combined with the market questionnaire in the quantitative research method to understand the data analysis and data statistics, and the evaluation results were obtained; In addition, in order to enhance the credibility and validity of the data, the study also used open-ended questioning to allow respondents to provide detailed views and suggestions. The author's master (Ms. Gao Nan - a senior engineer), when she worked in the enterprise (CRRC Group), gave a positive evaluation. She felt that applying the elements of regional cultural identity factors in the train design of Sichuan and



Figure 1. Sichuan-Chongqing (Chengdu Line 5) subway train design scheme

Source: Designed by Jianxiong Zhang

Chongqing entirely took into account the locality, culture, wisdom, and communication. The author's professional teacher (Mr. Xu Yongsheng-Ph.D./Associate Professor) at Southwest Jiaotong University commented that the application of regional cultural identity factor elements in train design entirely takes into account the culture, and pays more attention to the international communication, international memory and international experience of train design culture.

2) Data evaluation results. A total of 329 valid questionnaires were collected. In response to the question "Question 1, does the new plan reflect the regional cultural characteristics of Sichuan and Chongqing?", the survey data showed that 88.06% (286 votes) of the respondents believed that the new plan reflected the regional culture of Sichuan and Chongqing; In response to "Question 2, compared with the existing scheme of Sichuan-Chongqing (Chengdu Line 5) subway trains, whether the new scheme has more Sichuan-Chongqing cultural connotation", the survey data shows that 92.61% (287 votes) of the survey seven elephants believe that the new scheme has more Sichuan-Chongqing cultural connotation. The results show that the appearance scheme of the newly designed Sichuan-Chongqing (Chengdu Line 5) subway train fully characterizes and presents the regional culture and cultural literacy of Sichuan and Chongqing. The degree of recognition of cultural identity factors in Sichuan and Chongqing is high, which verifies the validity and correctness of the conclusion on optimizing regional cultural identity factors in Sichuan and Chongqing.

## DISCUSSION

This study applies Stuart Hall's cultural identity theory to the design of urban rail trains in Sichuan and Chongqing, highlighting the symbolic and cultural significance embedded in train aesthetics. From the perspective of the researchers, the visual identity of the train not only serves as a representation of regional culture but also functions as a medium for positioning Sichuan-Chongqing rail design on the global stage. The integration of cultural identity into train design fosters a unique symbolic structure that reflects both local cultural narratives and broader socio-cultural interactions between the Sichuan-Chongqing region and the international community. The imprint of regional culture in train aesthetics thus reinforces the distinctiveness of Sichuan-Chongqing's urban rail identity, ensuring that it is both locally rooted and globally recognized.

Expert discussions have provided critical insights into the study's methodological approaches and potential areas for improvement. Ms. Gao Nan, a senior engineer at CRRC Group, pointed out that while the AHP method and questionnaire surveys offer structured quantitative analysis, they may not fully capture the complexity and diversity of Sichuan-Chongqing's regional culture, potentially leading to the omission of key cultural elements. Similarly, Professor Xu Yongsheng from Southwest Jiaotong University emphasized the need to expand the research scale to enhance the comprehensiveness and applicability of the findings. Additionally, Professor Jiang Long

highlighted the effectiveness of the hierarchical structure model in evaluating cultural identity factors, emphasizing its logical rigor in statistical data analysis, test design, and ranking methodologies. The structured decomposition of cultural modeling, color, and connotation factors ensures the operability and scalability of the research outcomes. These expert insights affirm the study's methodological contributions while underscoring the necessity for future refinements to enhance its robustness and practical impact in design applications.

## CONCLUSION

This study systematically defines the regional culture of the Sichuan-Chongqing region and establishes a structured framework for its integration into subway train design. By categorizing cultural identity factors into three layers—material culture (outer layer), social culture (middle layer), and spiritual culture (inner layer)—this research identifies key regional elements, including modeling, color, and connotation factors. These identity factors serve as a reference system for incorporating local cultural characteristics into train design, addressing the lack of regional representation in existing subway aesthetics. The proposed model demonstrates strong systematization and practical operability, providing a theoretical foundation for extracting and quantifying cultural identity elements in design. Furthermore, through the Analytic Hierarchy Process (AHP), this study establishes a scientifically validated framework for selecting and optimizing cultural factors, supported by a structured process involving questionnaire design, judgment matrix construction, consistency verification, and factor ranking. The development of standardized evaluation tools enhances the accuracy and reliability of cultural integration in industrial design.

The practical application of Sichuan-Chongqing cultural identity factors in subway train design demonstrates the effectiveness of this approach. This study presents an innovative integration of cultural heritage into modern transportation aesthetics by incorporating these elements into train modeling, color schemes, and decorative features. The design scheme was further validated through empirical analysis and cultural evaluation, confirming the objectivity and feasibility of the proposed framework. Additionally, this research expands the interdisciplinary cultural and industrial design field in Sichuan and Chongqing, offering insights that can be applied to other regions. The findings contribute to China's subway design's evolution, providing theoretical guidance and practical support for cultural heritage preservation, literacy and innovation. While the study holds significant academic and practical value, it acknowledges certain limitations, including the need for broader research scope and larger sample sizes in future studies to enhance the generalizability and comprehensiveness of the findings. Ultimately, this research opens new avenues for the contemporary expression of Sichuan-Chongqing culture within modern transportation infrastructure.

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