



## Appropriate Trees along the Elevated Railway in Lamphun City, Thailand

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### Abstract

Thailand's Ministry of Transport aims to elevate the Den Chai-Chiang Mai double-track railway at Lamphun's Mueang Nga intersection, impacting the city's physical characteristics. This research focuses on harmonizing the large elevated railway with Lamphun's urban landscape and environment. Analyzing perspectives and considering perennial plant species selection, the study enhances visual aesthetics, shading, dust filtration, and heat reduction. Methodologically, it involves summarizing suitable plant information, simulating images with SketchUp, and analyzing before-and-after perspectives. Findings emphasize trees' positive environmental impact, recommending local species like the Cassia and symbolic species like the Thong Kwao for their adaptability and low maintenance.

Keywords: Environmental Design, Visual Frames, Visual Landscape, Elevated Railway

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### 1.0 Introduction

Thailand's transport infrastructure development strategy by the Ministry of Transport has a project to study the design of the Den Chai - Chiang Mai double-track railway (Daoreuk Channel, 2016). It is proposed to upgrade the railway tracks at the Mueang Nga intersection in the Lamphun area. It is a large structure that is important to the development of Lamphun city. In contemplating urban bridge design, it is imperative to extend considerations beyond structural aspects to encompass the urban environment. Traditionally, infrastructure is designed with a primary focus on functionality, limiting the potential of urban structures to enhance the city's positive image and cater to diverse urban life. Notably, elevated railway structures, despite their visibility, often need more architectural designs that create aesthetic impacts (Viljoen, 2018). Strategic plant selection and thoughtful incorporation into the urban landscape can enhance the visual appeal and contribute to the efficient utilization of space, thereby mitigating the overall size of the infrastructure. In the broader context, urban trees are essential for providing ecosystem services that significantly impact the quality of human life (Hamzah, 2021). This holistic approach aligns with contemporary urban design principles, ensuring the upgraded railway tracks meet functional needs and harmonize with the cityscape, fostering a more sustainable and aesthetically pleasing urban environment.

Selection of perennial plant species, design of perspective, elevation, and placement appropriate to the site context are critical physical elements in urban landscape design (Transport for NSW, 2023). That will help promote the area to be beautiful, attractive, and unique. It benefits the community both directly and indirectly, such as adding shade to the road, creating a green route, helping to filter

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dust, reducing heat and glare from large railway structures, and enhancing the softer scenery of the railway. If the environment is designed and the appropriate species selected along with the design of the elevated railway structure, Lamphun City will have an even better urban landscape. Therefore, it is best to study the appropriate plant species to be planted on either side of the elevated railway by conducting a design experiment at the Mueang Nga railway intersection, Lamphun Province.

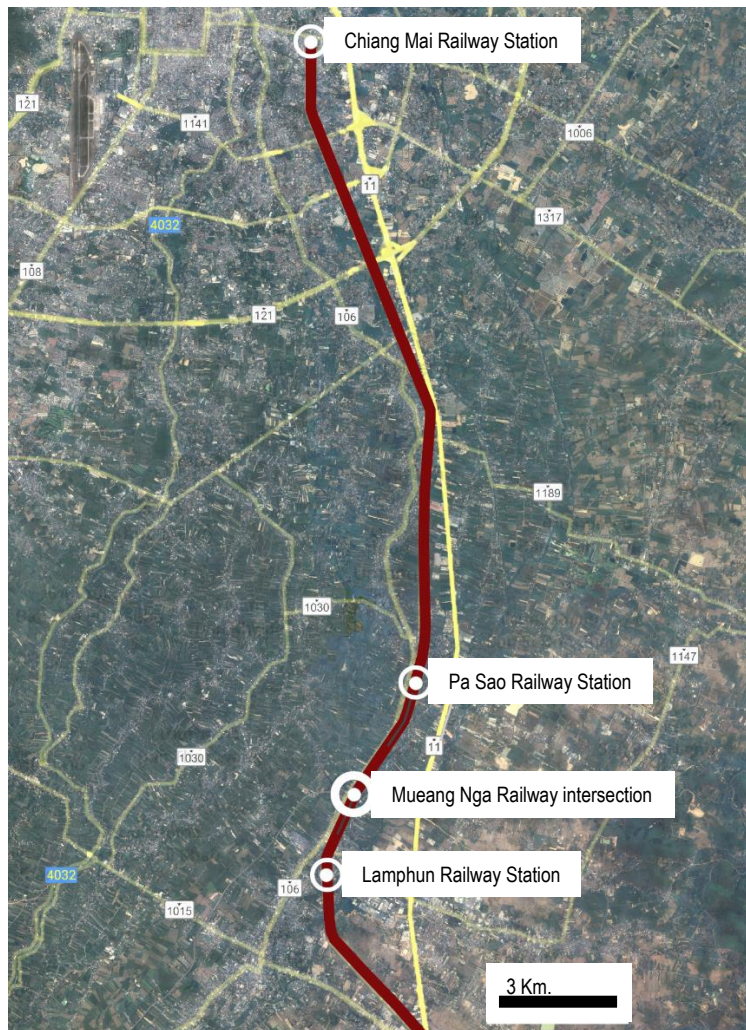


Fig. 1: Map showing the location of the Mueang Nga railway intersection.  
(Source: Google Earth)

### 1.1 Research objective

The research objectives involve collecting and assessing plant species for the elevated railway project at the Muang Nga railway intersection in Lamphun Province, guiding the selection of appropriate plants. The study objectively analyzes the visual framework and simulates the elevated railway, evaluating aesthetics and structure. This comprehensive approach aims to provide valuable insights for seamlessly integrating greenery and infrastructure in the project area.

## 2.0 Literature Review

### 2.1 Urban Design Framework

In landscape and natural environment measures, the enhancement and augmentation of habitat value and biodiversity within the corridor are paramount. The design of novel infrastructure and the strategic placement of elements prioritize the preservation of mature trees, remnant native vegetation, significant landscapes, and parkland. An overarching landscape design concept for the corridor endeavors is to elevate the extent and quality of existing and surrounding landscapes through a harmonized palette of color, form, and texture. The augmentation of canopy coverage involves strategically planting trees, especially along the rail corridor, active transport corridors, car parks, station forecourts, and public realms, serving multifaceted purposes such as shade provision, wind protection, stormwater drainage, comfort, and visual amenity. Plant selection, design, and layout exhibit resilience to climate changes, ensuring low maintenance and enduring outcomes tailored to micro-climates.

Moreover, deliberate plant selection and layout create a visual buffer between the new infrastructure and surrounding areas, fostering a seamless integration with the environment. The incorporation of Water Sensitive Urban Design (WSUD) opportunities within the design not only enriches biodiversity but also addresses stormwater management. Landscaped areas are meticulously designed to minimize grade steepness, facilitating plants' long-term establishment and growth. Furthermore, the design considers future maintenance requirements and fosters conditions conducive to the healthy growth of plants. Native or indigenous species are selectively used, particularly in environmentally sensitive zones and in alignment with the local context, ensuring a sustainable and contextually sensitive approach (The Victorian Government, 2020). Studying urban green spaces reveals benefits, including heat reduction, emphasizing green amenities, and enhancing well-being through inclusivity (Black & Richards, 2020).

## 2.2 The visual analysis

The analysis of the study area, particularly in the vicinity of the Mueang Nga railway intersection, necessitates a comprehensive consideration of the contextual links and project location. Human visual perception processes during road travel become integral, with research indicating that stationary objects have a lesser impact on driving than factors such as clarity and proximity-farness of objects. Environmental impact assessments, specifically on visual aesthetics, are crucial to preempt and mitigate potential visual pollution issues post-project completion, directly affecting the local populace and travelers. Anticipating future changes resulting from the railway upgrade at the Mueang Nga intersection, the study underscores the need for a design that conscientiously incorporates the identity and environmental value of the community, minimizing adverse impacts. Drawing from James J. Gibson's ecological approach to visual perception, the research delves into the psychological dynamics between individuals and their surroundings, encompassing visual, auditory, and tactile senses. Evaluating visual quality perspectives in urban design, emphasizing the clarity of vision concerning the visual cone guidelines, becomes paramount. The visual cone dictates a clear field of view without head movement, with a 120-degree span for clear vision, underscoring the importance of perceptual clarity in enhancing visual impressions during urban design evaluations (Gibson, 2014). This multidimensional approach aims to create a holistic understanding of the visual landscape, aligning with contemporary urban design principles and fostering a functional and visually harmonious environment.

## 2.3 Urban trees

Urban trees, whether in parks, yards, streets, or remnants, have played integral roles in urban design and landscape architecture for centuries. These trees remain crucial components of civic spaces, widely recognized for their considerable public value (Pataki, 2021). Plants have significantly influenced the environments humans inhabit, providing structure to both biological and cultural aspects. With their reliability and abundance in natural ecosystems, plants took on symbolic roles that reflected cultural needs. Their biological and physical features, including shapes and life cycles, became materials representing primal and divine forces on Earth. Plants acted as mediums through which these forces interacted and communicated with humans (De Carvalho, 2011).

National tree strategies acknowledge urban trees' diverse benefits for people and the environment. Global shifts, influenced by climate change and biodiversity concerns, emphasize urban trees' role in carbon storage, cooling, and wildlife habitat. Additionally, a growing awareness recognizes urban trees' positive impact on public health and well-being.

## 3.0 Methodology

3.1 Collect data and summarize information on suitable perennial plant species by analyzing preliminary data from the plan to improve the conservation and restoration of Cassia trees along the Chiang Mai - Lamphun Road, Umong Subdistrict. Furthermore, there has been an announcement from the Ministry of Natural Resources and Environment regarding the designation of areas and environmental protection measures in the areas of Wat Ket Subdistrict, Nong Hoi Subdistrict, Mueang Chiang Mai District, Nong Phueng Subdistrict, Yang Noeng Subdistrict, Saraphi Subdistrict, Saraphi District, Chiang Mai Province and the area of Umong Subdistrict, Mueang District, Lamphun Province (Ministry of Natural Resources and Environment, 2022) and other symbolic plant species such as Lamphun provincial plant species, consider these along with the tree's aesthetic characteristics (Hansen de Chapman & Alvarez, 2019).

3.2 The visual analysis starts with selecting a viewing point and recording the image as a model for comparison. Image recording selects images closest to the standard view at eye level. This method ensures a comprehensive examination of the visual landscape. The horizontal viewing angle has a viewing distance of 62 degrees, and the vertical viewing angle has a viewing distance of 50 degrees above and 70 degrees below (Gibson, 2014). This systematic approach provides a detailed understanding of the visual impact, facilitating thorough comparisons and informed decision-making in assessing the study area.

3.3 Simulating an image of an elevated train track with the SketchUp program involves the integration of data from the Skytrain in Bangkok (Mass Rapid Transit Authority of Thailand, 2018) and the Lopburi-Pak Nam Pho double-track railway project (Department of Rail Transport, 2021). This simulation is further enriched by incorporating images of the surrounding environment from selected viewpoints. This combination of information and simulated imagery seeks to provide a comprehensive visual representation of the proposed elevated train track. SketchUp facilitates a three-dimensional rendering that enables a detailed examination of the study area's potential visual impact and spatial relationships. This empirical approach, grounded in authoritative transportation data and environmental imagery, enhances the analytical depth of the visual simulation, contributing valuable insights for informed decision-making and thorough assessments of the elevated railway project.



3.4 Analyze and compare images before and after implementing landscape design, specifically focusing on selecting perennial plant species. This research aims to understand how carefully chosen plants transform the visual and environmental aspects of the landscape. By analyzing these perspective images, we seek to highlight the changes resulting from strategic landscape design. The study provides insights into the effectiveness of using specific perennial plants to enhance the area's overall appearance and ecological resilience. This approach contributes to the ongoing discussion on sustainable landscape design practices.

This research faces limitations in its reliance on simulated imagery and predefined viewpoints for visual analysis, which may not fully capture the dynamic and comprehensive visual impact of the elevated railway project and landscape changes on the environment.

## 4.0 Findings

4.1 The result of selecting trees that express the city's identity is the Cassia tree, planted along both sides of the road in Lamphun Province, continuous with the rubber trees of Chiang Mai Province on the Chiang Mai-Lamphun Road, forming a cohesive and emblematic green corridor. This road has been designated as an environmental protection area on two sides of the road, and the Thong Kwao tree was selected because it is the provincial flower of Lamphun Province (Lamphun Provincial Office, 2022). Noteworthy for their resilience, the Cassia and Thong Kwao trees are perennial plants well-suited to withstand Lamphun's diverse climate, contributing to the sustainable and aesthetic enhancement of the region's urban landscape. Therefore, ensuring the continuous well-being and safety of urban trees is crucial. This selection underscores the importance of carefully selecting well-suited trees for the specific area, as it enhances their resilience and reduces maintenance costs.

The Cassia tree, scientifically known as *Senna Siamea*, is a deciduous tree characterized by its medium size, typically reaching heights of 8 to 15 meters. This species is distinguished by its clusters of vibrant yellow flowers adorning the terminal ends of its branches, contributing to the visual allure of the landscape. Beyond its ornamental appeal, the Cassia tree holds practical significance as well. The young shoots and flowers of the Cassia tree are culinary resources suitable for cooking. (Plant Information Management System of Chiang Mai University, 2020) This dual-purpose attribute enhances its value as an aesthetic element and a resource with potential utility. As part of the thoughtful urban planning, Cassia trees are strategically slated for planting on both sides of the road, running parallel to the railway line, ensuring a harmonious integration of botanical aesthetics within the urban fabric.

1.2 The Thong Kwao tree is the provincial flower of Lamphun. It is a medium-sized tree. The average height is approximately 12 -18 meters. The scientific name is *Butea Monosperma* (Plant Information, 2017). It is planted along the railway tracks because the Thong Kwao tree is of the appropriate height to block the light reflecting from the concrete structure of the elevated railway so as not to disturb the people living around the elevated railway area.

### 4.2 The key view analysis

The results of selecting perspectives were analyzed from the angles that had the greatest opportunity to be seen, including 1) the view from National Highway No. 1136, Mueang Nga-Lamphun, which is a road separated from Highway No. 11, and the view from rural highway L.P. 4025 or Lamphun Bypass Road. Both views view the study area in the form of side-by-side images, which provide both a wide view from a distance and a close-up view. 2) View from the road along the Chiang Mai-Lamphun railway, both roads heading from Lamphun Province to Chiang Mai Province and from Chiang Mai Province to Lamphun Province. These views from the road provide a close-up view of the study area flanking the road, and 3) the view from houses along the road parallel to the railway line, which can be seen near the distance. Only the foundation and pillars of the structure can be seen from a normal eye-level perspective.

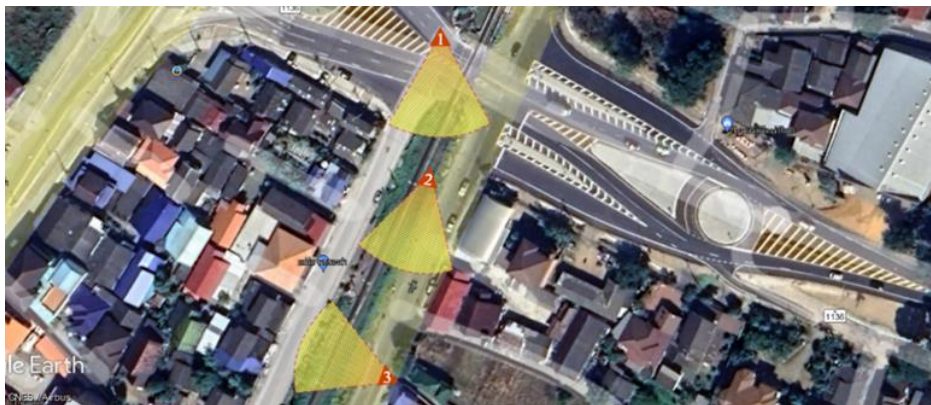


Fig. 2: Shows the location of the key views.

### 4.3 Simulation of an elevated railway

The elevated railway structure is placed on a single pillar, 9 meters wide and approximately 10 - 12 meters high. It is precast concrete in pieces assembled one column at a time. The track width is approximately 2 meters, and the pole spacing is approximately 35 meters.

In cases where the runway structure must cross a road intersection and requires a runway that is longer than a normal runway, a special length runway can be designed up to 40-60-40 meters, with the height of the running wheels depending on the local conditions (Mass Rapid Transit Authority of Thailand, 2018; Department of Rail Transport, 2021).

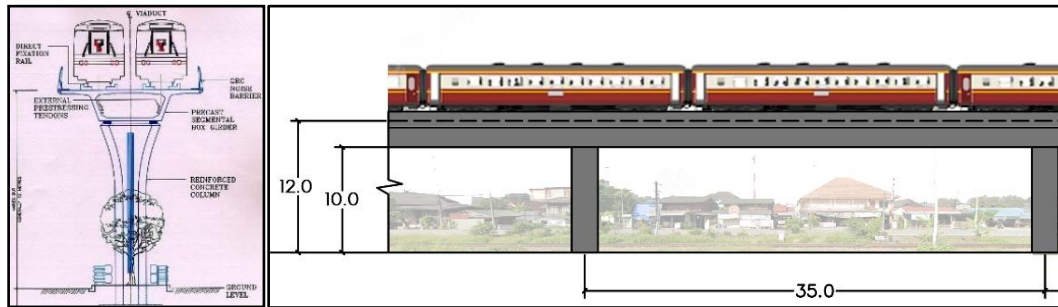


Fig. 3: Simulated image showing the rail height and the piers' distance.  
(Source: developed from Mass Rapid Transit Authority of Thailand, 2018.)

4.4 The results of analyzing the perspective images by comparing the before and after images of the landscape design with Thong Kwao and Cassia trees from all three perspectives found that they can block the view of the concrete structure and increase the greenness of nearby houses.



Fig. 4: Simulates the vision according to the key view 1.





Fig. 5: View from the railway road showing the pier bases and floor of the elevated railway structure (Key view 2)

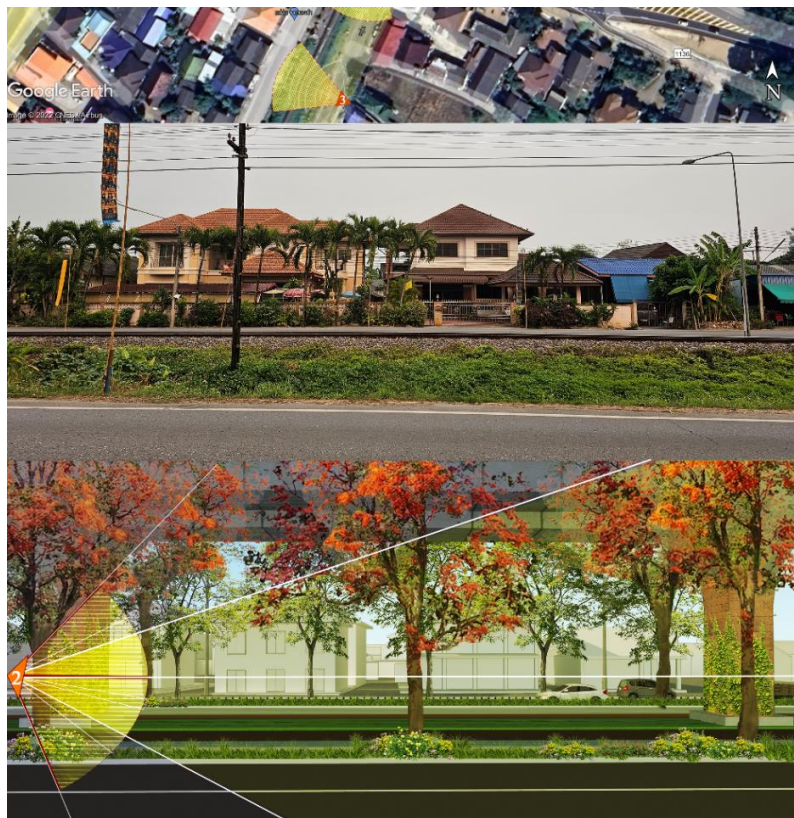


Fig. 6: The view of the elevated railway from the houses next to the railway, with Thong Kwao trees planted on both sides of the elevated railway to obscure the large concrete structure (Key view 3)

## 5.0 Discussion

The results can be discussed as follows.

5.1 Visual assessment is an automatic process. The visual cone is the visual limit. (Gibson, 2014). Therefore, when designing an environment that emphasizes the visual framework, it will be possible to determine the framework for considering the design details. In this regard, trees will be an element that helps promote the environment's quality and highlight their importance in creating a richer environmental atmosphere.

5.2 Trees enhance the beauty of the environment (Hansen & Alvarez, 2019). Characteristics of trees that enhance the beauty of the environment are determined by the tree's shape, the size of the tree's leaves, the size of the canopy and height of the tree, and the color of the tree. When considered with the visual framework, plants that are good for the design environment can be selected.

5.3 Selecting native plants symbolic of the local area will help promote a positive experience for those who see them. In addition, native plants can grow naturally, reducing maintenance and being highly resistant to the local environment. (Pataki, 2021; De Carvalho, 2011)

5.4 The development of large-scale infrastructure, such as the electric railway, should be considered together with the development of other physical environments to increase the quality of cities for living. It should also consider the area's potential, such as local plant species that help reduce maintenance because they are suitable plants. It should also be considered in conjunction with the visual frame to define the design details more clearly.

The research underscores the significant implications of integrating urban green spaces, tree selection, and visual analysis in urban design, extending beyond the case studies to broader urban development practices. It highlights cities' need to adopt comprehensive urban design frameworks that prioritize environmental conservation, biodiversity enhancement, and the strategic placement of green infrastructure. This approach addresses aesthetic and ecological considerations and supports public health, well-being, and resilience to climate change. Future urban planning endeavors should leverage these insights to create visually appealing, ecologically vibrant environments, and conducive to fostering a sense of community and identity. Incorporating these principles can lead to the development of cities that are not only sustainable but also harmonious with their natural surroundings, enhancing the quality of life for all inhabitants.

## 6.0 Conclusion & Recommendations

In conclusion, our research underscores the pivotal role of plant species selection in landscape design, particularly evident in the Mueang Nga Intersection's elevated railway project in Lamphun Province. The choice of the Cassia tree for its historical significance and the Thong Kwao tree representing Lamphun significantly shape the area's visual and ecological aspects. Our analysis underscores the profound impact of these choices on the overall landscape, guided by visual assessment through the automatic process of the visual cone, influencing design considerations.

Furthermore, the deliberate selection of native plants enhances visual appeal and fosters a positive experience, as observed in Lamphun Province. Aligned with the visual framework, local plant species prove essential for sustainable and low-maintenance landscaping. On a broader scale, integrating large-scale infrastructure, such as the elevated railway, with thoughtful consideration of the local context and visual elements is crucial for successful urban development. This integrated approach ensures a harmonious blend of historical, symbolic, and contemporary elements, contributing to the quality of urban living.

Our research delves into the intricate interplay between plant selection, visual aesthetics, and ecological considerations in urban landscape design, providing a valuable framework for future projects aspiring to achieve a sustainable and visually appealing urban environment.

Upon retrospective evaluation, our research substantively contributes to landscape design theory and practice, exemplified by its application in the Mueang Nga Intersection project. Identifying the significance of plant selection and visual considerations broadens the understanding of urban development. However, guidelines from the research involved in the public hearing will help in more efficient and clear design guidelines. Research limitations include a narrow focus on physical development and plant selection. The effectiveness of design guidelines relies on specific public hearing research recommendations, requiring further scrutiny for a comprehensive understanding.

To optimize urban environments through design and plant selection, it is recommended to integrate a visual framework that prioritizes the inclusion of trees and native plants. Leveraging the concept of the visual cone as a guide, urban planners should select trees and plants based on their aesthetic qualities—such as shape, size, and color—and their ability to enhance the environment's beauty and functionality. Trees, in particular, should be chosen for their capacity to improve air quality, provide shade, and contribute to the overall aesthetic appeal of the area, as supported by Hansen and Alvarez (2019).

Emphasizing the selection of native and symbolic plants will ensure these green spaces resonate with local heritage, promoting a sense of identity and reducing maintenance needs due to their adaptability to the local climate (Pataki, 2021; De Carvalho, 2011). In the context of integrating large-scale infrastructure, such as electric railways, it is crucial to align the development with the local environment by selecting suitable plant species that can soften the visual impact of such structures, thereby enhancing the quality of urban living spaces while preserving historical and cultural significance, exemplified by the use of Cassia trees and Thong Kwao flowers in Lamphun Province.

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## Paper Contribution to Related Field of Study

The study delves into the transformative impact of integrating urban landscape design into infrastructure development, specifically the Den Chai-Chiang Mai double-track railway project at the Mueang Nga intersection in Lamphun Province, Thailand. It emphasizes transcending conventional infrastructure design by incorporating aesthetic and ecological considerations, enhancing the urban environment. The strategic selection and placement of perennial plants are posited to uplift the visual appeal and offer practical urban benefits like temperature regulation and dust filtration, contributing to the sustainable development of Lamphun City.

The research outlines an approach that considers the visual framework and simulates the railway with selected plant species, aiming to achieve a harmonious blend of greenery and infrastructure. Key findings highlight the selection of Cassia and Thong Kwao trees for their symbolic significance to the local identity and their ecological resilience. These species are shown to soften the railway structure's visual impact, enriching the green corridor and enhancing the living quality in urban settings.

The discussion underscores the automatic visual assessment process and the crucial role of trees in enhancing environmental beauty within a design framework. The study advocates for the selection of native plants that resonate with the local context, are low-maintenance, and support ecological sustainability. The conclusion asserts the importance of integrating large-scale infrastructure projects with local flora, enhancing urban living quality through a thoughtful design that respects the visual, historical, and environmental context. The research provides a framework that can guide future sustainable urban landscape projects, emphasizing the significance of public involvement in refining design guidelines.

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