Erciyes Üniversitesi
Fen Bilimleri Enstitüsü Dergisi
Cilt 41, Sayı 1, 2025

Erciyes University
Journal of Institue Of Science and Technology
Volume 41, Issue 1, 2025

Designing Climate-Responsive Learning Environments: Rethinking Educational Buildings Across Türkiye's Diverse Climatic Zones

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(Alınış / Received: 20.02.2025, Kabul / Accepted: 19.04.2025, Online Yayınlanma / Published Online: 30.04.2025)

Keywords
Climate-responsive design,
Cognitive performance,
Educational buildings,
Indoor comfort,
Türkiye,
Student health and well-being

Abstract: The design of educational buildings plays a crucial role in students' comfort, well-being, and the functionality of their learning environments, with climate-responsive design being critical for addressing global climate challenges, ensuring energy efficiency, sustainability and resilience to extreme weather conditions in addition to occupant comfort. In Türkiye, the impact of varying climatic conditions on school design is often disregarded, resulting in the use of uniform designs that may not meet regional climatic needs, potentially leading to concerns with indoor comfort, energy efficiency, air quality, and, ultimately, adversely impacting student health, well-being, and academic performance.
This study aims to investigate the uniformity of educational building designs across Türkiye’s climatic regions evaluate their climate responsiveness and predict the potential short- and long-term impacts on student health, well-being, and academic performance in cases where climate-responsive design is insufficient. Köppen climate classification was used to categorise Türkiye's climatic zones and select pilot cities with extreme heat and cold conditions. The educational buildings in these cities were evaluated for design uniformity and climate responsiveness. Finally, the potential impacts of the identified uniformity and lack of climate-responsive design were synthesised from the literature.
The findings revealed that despite significant climatic differences, many schools in Türkiye share similar designs that do not adequately address regional climate needs, which could have important implications for both the learning environment and student equity, potentially exacerbating disparities between students in different regions. The study emphasises the critical need to incorporate climate-responsive design strategies in educational buildings to enhance not only the current indoor conditions but also to address future challenges posed by climate change, improve energy efficiency, and, most importantly, foster equitable and supportive learning environments for all students. Further experimental studies are recommended to assess the impact of climate-responsive design on students' health, well-being, and cognitive performance.

İklime Duyarlı Öğrenme Ortamları Tasarlamak: Türkiye'nin Çeşitli İklim Bölgelerinde Eğitim Binalarını Yeniden Düşünmek

Anahtar Kelimeler
İklime duyarlı tasarım,
Bilişsel performans,
Eğitim binaları,
İç mekan konforu,
Türkiye,
Öğrenci sağlığı ve iyi olma hali

Öz: Eğitim binalarının tasarımı, öğrencilerin konforu, refahı ve öğrenme ortamlarının işlevselliği açısından önemli bir rol oynamaktadır. İklime duyarlı tasarım, küresel iklim zorluklarını ele almak, enerji verimliliği, sürdürülebilirlik ve aşırı hava koşullarına dayanıklılığın yanı sıra kullanıcı konforunun sağlanması açısından kritik öneme sahiptir. Türkiye'de, değişen iklim koşullarının okul tasarımı üzerindeki etkisi genellikle göz ardı edilmekte ve bu da bölgesel iklim ihtiyaçlarını karşılayamayan tek tip tasarımların kullanılmasıyla sonuçlanmaktadır.

Bu durum iç mekan konforu, enerji verimliliği, hava kalitesiyle ilgili endişelere yol açabilmekte ve nihayetinde öğrenci sağlığını, refahını ve akademik performansını olumsuz etkileyebilmektedir.
Bu çalışma, eğitim binası tasarımlarının Türkiye'nin iklim bölgeleri genelinde tekdüzeliğini araştırmayı amaçlamaktadır. İklime duyarlılıklarını değerlendirmek ve iklime duyarlı tasarımın yetersiz olduğu durumlarda öğrenci sağlığı, refahı ve akademik performansı üzerindeki olası kısa ve uzun vadeli etkileri tahmin etmekte çalışmanın amaçları arasında yer almaktadır. Köppen iklim sınıflandırması, Türkiye'nin iklim bölgelerini kategorize etmek ve aşırı sıcak ve soğuk koşullarına sahip pilot şehirleri seçmek için kullanılmıştır. Pilot şehirlerdeki eğitim binaları tasarım tekdüzeliği ve iklime duyarlılık açısından değerlendirilmiştir. Son olarak, belirlenen tekdüzeliğin ve iklime duyarlı tasarım eksikliğinin potansiyel etkileri literatürden sentezlenmiştir.
Bulgular, önemli iklim farklılıklarına rağmen, Türkiye'deki birçok okulun bölgesel iklim ihtiyaçlarını yeterince karşılamayan benzer tasarımlara sahip olduğunu ve bunun hem öğrenme ortamı hem de öğrenci eşitliği için önemli sonuçlar doğurabileceğini, farklı bölgelerdeki öğrenciler arasındaki eşitsizlikleri daha da kötüleştirebileceğini, ortaya koymuştur. Çalışma, yalnızca mevcut iç mekan koşullarını iyileştirmek için değil, aynı zamanda iklim değişikliğinin oluşturduğu gelecekteki zorlukları ele almak, enerji verimliliğini artırmak ve en önemlisi tüm öğrenciler için eşit ve destekleyici öğrenme ortamları yaratmak için eğitim binalarına iklime duyarlı tasarım stratejilerinin dahil edilmesinin kritik ihtiyacını vurgulamaktadır. İklime duyarlı tasarımın öğrencilerin sağlığı, refahı ve bilişsel performansı üzerindeki etkisini değerlendirmek için daha fazla deneysel çalışma önerilmektedir.

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1. Introduction

Educational environments have a crucial role in students' learning outcomes [1] by influencing their motivation, academic performance, health and well-being [2]. These environments involve a range of elements, including physical, social and psychological factors that can be used to positively impact students' sense of belonging in the school environment, improve their engagement and support students with diverse learning needs [3]. A critical aspect of these environments consists of physical conditions such as air quality, temperature, lighting, and noise level. The optimum physical conditions in educational environments are achieved with climate-responsive design, referring to architectural strategies to design buildings to respond to local climatic conditions, considering both buildings' energy performance against both current and future climatic challenges and students' environmental needs and expectations [4].

Future climate projections for 2030, 2050, and 2070 predict an average global temperature increase of 2.7 °C, intensifying the challenges faced by existing educational buildings. Rising temperatures and shifting climatic conditions contribute to increased energy consumption for heating, cooling, and ventilation, alongside straining resources and exacerbating environmental impacts [5]. To address these challenges, improving energy efficiency through advanced building design strategies, such as high-performance insulation, upgraded windows, and optimised building envelopes, has become a priority. These measures can reduce a school building's energy consumption by 50% to 57% annually while enhancing resilience to future climatic variability [6]. Anticipatory educational buildings, designed with future climate conditions in mind, are essential for maintaining safe, comfortable, and effective learning environments [7]. Beyond reducing energy consumption, climate-responsive design of learning environments plays a critical role in promoting educational equity by creating inclusive and adaptable spaces. These designs support student engagement and equip learners with effective coping strategies to address climate-related challenges. Ensuring that all students, regardless of their geographical location or local climate, have access to equitable and inclusive learning environments reflects a global commitment to inclusivity. Providing equal education opportunities, where no physical differences in built environment conditions or climate-related challenges hinder learning outcomes, contributes to a more resilient and informed future generation.

Creating a comfortable indoor environment requires assessing the climatic comfort conditions and understanding the perceived climatic needs of students at an early stage of the architectural design process [8]. Although considerable attention is given to climate-responsive design for enhancing indoor environments in effective learning environments, this consideration is often overlooked in the architectural designs of educational buildings in certain countries, such as Türkiye.

Despite the diverse climatic conditions in Türkiye, educational institutions are usually constructed based on similar typological design standards [9], which may pose a significant challenge to developing educational buildings that promote equality in the learning environment.
Typological approaches to educational building design often result in homogeneous learning environments that fail to meet the diverse needs of students in different contexts [10]. These uniform designs typically emerge during rapid expansion phases driven by administrative organisations, as they are considered both economically and practically advantageous for addressing the increasing demand for educational facilities. While such designs are recognised for their affordability and efficiency, they often fall short of indoor comfort and energy efficiency [11]. Research indicates that optimising indoor comfort strategies is crucial, especially in educational settings where the well-being of users directly influences learning outcomes [12]. These deficiencies, therefore, may exacerbate educational inequalities, inadvertently disadvantaging students in certain regions.

This study aims to examine whether educational buildings in Türkiye are designed uniformly across different climatic regions, evaluate their climate responsiveness, and, in cases where climate responsiveness is lacking, predict the potential short and long-term adverse impacts on student health and well-being and academic performance, to promote equitable learning environments. This research utilised the Köppen climate classification as the most widely used global climate classification system [13] to categorise Türkiye's climatic zones and selected pilot cities representing regions with extreme heat and cold conditions. The application of this classification to examine educational buildings in Türkiye, where such an analysis has not been previously conducted, highlights the significance of this research [14]. Following this, the educational buildings in these cities were assessed for design uniformity through architectural planning and overlapping analysis. In the next phase, the climate responsiveness of the selected buildings is evaluated based on key design parameters, including orientation, spatial layout, window-to-wall ratio, and other climate-responsive features, to determine how well these buildings adapt to their local environmental conditions. After identifying the uniformity of educational buildings across various climatic conditions and evaluating their lack of climate-responsive design, in the final phase, the potential short- and long-term impacts of this situation were synthesised using insights from the literature. This research highlights the often-overlooked intersection of climate, design, and education, contributing to the ongoing discourse on creating equitable learning environments. It offers valuable insights for administrative bodies, ministries of education, architects, and educators to rethink and redesign school building infrastructure in ways that foster equitable learning opportunities and support academic success for all students.

2. Background

2.1. The role of the physical environment in the learning environment

Educational environments play a critical role in shaping the students' learning experience, positively influencing both cognitive performance and emotional well-being [15]. Numerous studies have consistently shown that indoor environmental quality (IEQ) factors, such as lighting, thermal comfort, air quality, and noise levels, directly affect students' concentration, classroom participation and overall academic success [16]. For instance, classrooms with sufficient daylight and proper ventilation enhance students' cognitive performance during lessons, whereas poor thermal conditions or inadequate acoustics interfere with the learning process of students and increase their stress levels [17]. Evidence suggests that low lighting levels and poor air quality in learning environments can reduce cognitive performance by up to 36%, whereas optimal indoor comfort conditions, such as good lighting and optimum air quality, enable 90% of students to complete given tasks effectively and on time [18]. Additionally, high lighting levels have a booster impact on the time students spend on task completion by 41.7%. Similarly, maintaining the classroom temperatures between the optimum range of 22.4°C and 24.7°C significantly improves students' cognitive performance [19]. Excessive noise levels, on the other hand, adversely impact students' hearing and comprehension abilities, thereby disrupting functional learning [20]. For this reason, designing learning environments that adequately address students' physical and cognitive requirements is crucial to guiding them toward achieving successful educational outcomes. Therefore, in countries like Türkiye, with diverse and extreme climatic conditions, it is essential to prioritise indoor environmental quality (IEQ) and adapt educational buildings to local climates using climate-responsive design strategies, not only supporting environmental sustainability but also ensuring student comfort, promoting equitable and effective learning environments across all regions.

Standard projects primarily function as models utilised by the state to deliver rapid and cost-effective solutions while also being preferred for their ability to reduce planning errors [21]. They are typically designed and implemented by architects in a pilot region, often without considering critical factors such as land, climate, context, and topography related to the specific function of the project, whether it be for health, education, or other public structures [22]. Consequently, these standard educational designs overlook significant factors that are critical for countries with diverse climatic conditions, such as Türkiye, which experiences a range of climates from the hot, dry summers of the Mediterranean and Aegean regions to the cold winters of Eastern Anatolia.

Despite the significance of climate-responsive design, public school buildings in Türkiye are typically constructed using standardised architectural projects that rely on repetitive organisational layouts, neglecting to account for climatic conditions [23]. The standard educational structures are revised based on heat calculations and ground survey characteristics specific to the regions where they will be implemented. However, these revisions do not incorporate a building design approach that considers the local climate [24].
Educational building designs must prioritise user comfort both in the short and long term while also being mindful of the local climate conditions. The climate of the area where a building is constructed is a crucial factor that should not be overlooked when considering indoor thermal comfort. Additionally, school buildings should be designed with a flexible planning approach that not only addresses the needs of the current time but also considers the future requirements of upcoming generations of students. The typical one-size-fits-all strategy can adversely impact the quality of indoor comfort in educational spaces, particularly in areas with extreme climatic conditions [25]. For instance, schools located in hot climates often face challenges with excessive heat accumulation and insufficient cooling. In contrast, those in colder climates may not have the necessary insulation to keep temperatures comfortable [26]. Such deficiencies in the built environment can result in discomfort, reduced cognitive performance, and negatively impact students' overall well-being. In conclusion, the design of upcoming school buildings should be tailored to ensure they are conducive to education and provide a comfortable indoor environment. In this regard, there is an urgent need to reconsider the architectural design of educational facilities in Türkiye better to address the environmental requirements of various climate zones.

2.2. Climate-responsive educational building design

Climate-responsive building design has gradually emerged as a vital strategy for creating sustainable and comfortable learning environments, effectively addressing the urgent need for energy efficiency and improved indoor comfort in educational facilities. Key parameters of climate-responsive building design include optimising natural ventilation, thermal mass, shading, and orientation to adapt to climatic conditions, enhancing comfort and energy efficiency [27] [28]. The climate responsiveness of this study was evaluated using the architectural drawings of school buildings in the predefined pilot cities. Consequently, the parameters for the climate-responsive design were limited to the information obtained from these drawings, such as building orientation, insulation, shading, and the ratios of window-to-floor area (WFR) and window-to-wall area (WWR). These design parameters can be further elaborated as follows;

Building Orientation: There is no universally correct building orientation that applies across all climatic conditions. For instance, in warm climates, a southern orientation is preferred to maximise solar gain during the winter while minimising it in the summer. Benharchache et al. (2023) have shown that southern, northern, and eastern orientations are optimal for building placement in various regions of Algeria, significantly enhancing energy conservation.
Insulation material and thickness: The application of insulation is influenced by regional conditions, the type of materials utilised, and their thicknesses. Research conducted by Amani (2024) indicated that insulation materials such as polystyrene and bio-composite fibers have substantially reduced energy consumption in specific regions, resulting in savings that exceed 45%. Researchers also showed that effective thermal insulation can reduce heat loss from roofs by 14.2% and from walls by 26.5%, resulting in significant energy savings in warm and humid climates.
Window-to-Wall Area Ratio (WWR): The window-to-wall area ratio (WWR) refers to the proportion of window area to the total exterior wall area of a building. An optimised window-to-wall area ratio (WWR) can provide substantial energy savings; for instance, a recommended WWR of 65% is suggested for south and east-facing facades in Mediterranean climates [31]. Conversely, A WWR exceeding 70% should be avoided in hot climates unless adequate shading is provided to prevent excessive heat gain [32].
Window-to-Floor Area Ratio (WFR): The window-to-floor area ratio (WFR) is another crucial parameter for optimising natural light, enhancing indoor comfort, and improving energy efficiency. Mirrahimi et al. (2013) suggested that a WFR of 15% to 20% is ideal for classrooms in Malaysia, providing sufficient daylight considering the temperature and humidity of the tropical climate. On the other hand, a higher WFR of approximately 20% is generally recommended in temperate regions like Europe, where sunlight is less intense, to ensure adequate daylighting [34].
Sun-Shading Elements: Integrating practical sun-shading elements, such as overhangs and shutters in building facades can significantly reduce cooling energy consumption, particularly in regions with high solar radiation, while improving thermal comfort [35].
Future Considerations: As climate change increases the demand for cooling, building designers are encouraged to incorporate future climate scenarios into their design processes to ensure comfort and efficiency in hotter regions [36].
Global examples illustrate that climate-responsive design strategies, such as optimising building orientation and enhancing thermal comfort, can yield significant energy savings.

Studies showed that these strategies have achieved up to 12% greater energy efficiency compared to traditional methods in India [37], whereas educational buildings in hot-dry and hot-humid regions, like Iran, have also benefited from optimal building orientation and the incorporation of green areas for shading, leading to improved energy efficiency and user comfort [38].
These diverse climate examples underscore the potential advantages of climate-responsive design in creating learning environments that prioritise both student comfort and energy efficiency, offering valuable insights for Türkiye. Achieving a balance among climate-responsive design parameters is crucial for developing equitable educational environments that align with optimal building performance and occupant comfort in various climate conditions. Thus, this research has developed design recommendations to provide maximum occupant comfort and equitable learning environments across various climates, particularly focusing on these key parameters.

2.3. The role of learning environment on educational equity

The physical conditions of educational environments typically depend on a standardised design, which often fails to meet the unique needs of different regions, leading to issues of equity [39]. Research indicates that over 90% of educational institutions suffer more damage from disasters, particularly those in communities with limited funding or adverse climate conditions [40]. This situation highlights that students in regions facing challenging climate conditions are more vulnerable to harmful environmental factors, which can negatively impact their academic performance and overall health and well-being.
In Türkiye, disparities in educational infrastructure between central and peripheral regions and changing climate conditions exacerbate existing inequalities. Infrastructure damage during the winter season can result in extended class cancellations, leading to a loss of productive class hours. The cancelled classes each day due to environmental factors can also cause missed opportunities for students to learn and issues of equity among students in various climatic conditions [41]. Conversely, students in well-funded or temperate regions benefit from climate-appropriate and comfortable learning environments, whereas those in harsher climates encounter numerous challenges that undermine their motivation to learn, including health issues and anxiety related to natural disasters [42].

Educational equity encompasses not only access to education but also the right of all students to learn in physically suitable and comfortable environments that promote their well-being. In regions with extreme climate conditions, students encounter additional obstacles such as thermal discomfort and poor air quality in educational settings, as school buildings are often not designed to meet the specific climatic needs of the area. Although governments have implemented various policies to address these challenges, such as adjusting school timetables and developing heat response plans, significant gaps remain in effectively addressing posed by climate change [43]. Despite the implementation of various policies by governments to address these challenges, such as adjusting school timetables and developing heat response plans, significant gaps persist in effectively addressing the issues posed by climate change. Consequently, the climatic suitability of learning environments has emerged as a critical area of research, given its profound impact on students' motivation, health, and academic performance.

2.4. Aim and hypotheses

School environments, where students spend the majority of their time, are essential not only for energy efficiency and sustainability but also for their physical, cognitive, and psychological health, as well as their academic performance [44]. The literature indicates that deficiencies in comfort, such as inadequate heating, cooling, and ventilation, within educational environments adversely affect students' motivation, concentration, and overall health [45]. For instance, insufficient natural lighting diminishes visual comfort and cognitive performance [46], while a lack of thermal comfort poses risks to physical health in the learning environment [47]. Therefore, the widespread adoption of standardised project designs, often implemented for economic and practical reasons, overlooks local climate differences, which may lead to school buildings in various climatic zones, such as those in Türkiye, failing to meet user needs and neglecting crucial factors like indoor comfort, energy efficiency, air quality, and the principle of equitable education.

Despite a substantial body of research on the impact of environmental factors on learning [48], relatively few studies in Türkiye have specifically explored the role of climate-responsive design in enhancing educational equity [49]. Current research on educational buildings in the country has mainly focused on standardised project design, frequently neglecting the unique challenges presented by specific climatic conditions in various regions, as well as the discomfort stemming from the inequitable environments in which students learn [50]. Moreover, the relationship between climate-responsive building design and students' cognitive performance remains an under-explored area within the Turkish context.

This study aims to examine whether educational buildings in Türkiye are designed uniformly across different climatic regions, evaluate their climate responsiveness, and, in cases where climate responsiveness is lacking, predict the potential short- and long-term adverse impacts on student health, well-being, and academic performance. This research utilised the Köppen climate classification to categorise Türkiye's climatic zones and selected pilot cities representing extreme heat and cold regions. Following this, the educational buildings in these cities were assessed for design uniformity through architectural plan analysis and overlapping analysis. In the next phase, the climate responsiveness of the selected buildings is assessed based on key design parameters, including orientation, spatial layout, window-to-wall ratio, and other climate-responsive features, to determine how well these buildings adapt to their local environmental conditions. After identifying the uniformity of educational buildings across various climatic conditions and evaluating their lack of climate-responsive design, in the final phase, the potential short- and long-term impacts of this situation were synthesised using insights from the literature.

The key hypotheses guiding this study are as follows:
Hypothesis 1: Educational buildings in Türkiye are designed uniformly across different climatic regions, regardless of local climate conditions.
Hypothesis 2: The climate responsiveness of educational buildings in Türkiye is insufficient to meet the specific needs of students in varying climatic zones.
This study explores how climate-responsive design strategies can advance equity in education by enhancing indoor comfort, fostering supportive learning environments for all students, and improving energy efficiency. It seeks to deepen the understanding of the relationship between architecture, climate, and educational outcomes, providing valuable insights for future design practices and policies that prioritise sustainability and equity. Furthermore, the research emphasises the necessity of a flexible planning approach in designing educational facilities to address future climate comfort needs resulting from climate change.

3. Material and Method

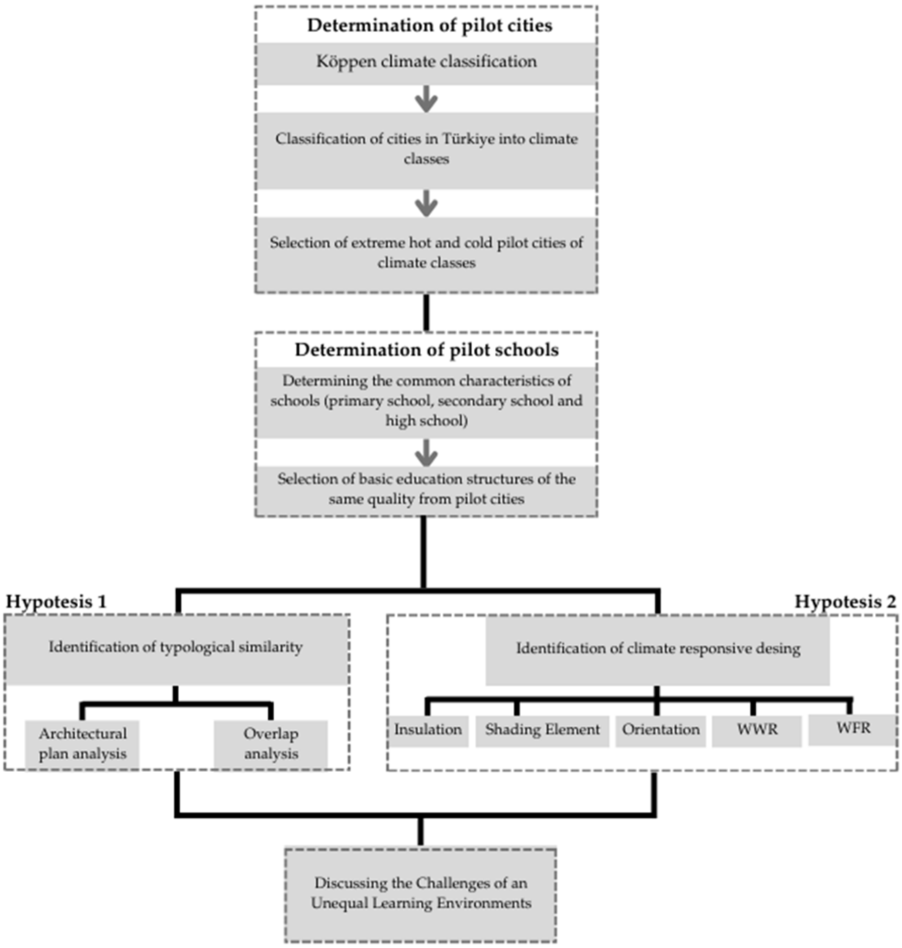


Figure 1. Methodology Flow Diagram

The accompanying diagram (**Figure 1**) illustrates the methodology flow, which visualises the methodology's narrative. It was observed that educational structures concerning standard projects focused on thermal comfort and the Köppen Climate Classification across different climate types had not been analysed. This gap highlights one of the study's originality. Considering its global recognition, the Köppen Climate Classification was selected for its validity and applicability in this research. Data on provinces and districts were sourced from the tables titled "Climate Type and Climate Characteristics of Our Provinces and Some Districts According to Köppen," obtained from the General Directorate of Meteorology [51]. Additionally, the annual average temperature, as well as the average highest and lowest temperatures for each province in Türkiye classified by climate type, were visualised using information from the "Seasonal Normals of Our Provinces (1991-2020)" table published by the General Directorate of Meteorology [52]. Since districts are not included in this publication, their annual average temperatures were accessed through the Weather Spark website [53]. In light of this information, tables were created for each climate type, presenting annual average temperature, average maximum temperature and average minimum temperature data in the context of the Köppen Climate classification of cities in Türkiye (**see Appendix 1**).

The produced data was transformed into three stages of graphs to clarify the climate data of Türkiye, and define pilot cities and schools for analysis. In the first stage, the general average temperatures of Türkiye, including the average highest and lowest temperatures, were converted into graphs (see **Figures 2, 3, and 4**). Secondly, ten Köppen climate types seen in Türkiye were compared through graphs of average, highest, and lowest temperatures, highlighting pilot cities that exemplify each climate type (see **Figures 5,6,7**). Lastly, predefined pilot cities with extreme temperature characteristics were compared with each other, focusing on extremely hot and cold cities (see **Figures 8 and 9**). The similar characteristics of primary, secondary and high schools to address the changing needs of users across different age groups were then tested based on two following hypotheses;

The first hypothesis of this study was whether educational buildings in Türkiye are designed uniformly across different climatic regions, regardless of local climate conditions. Firstly, educational buildings in Türkiye were compared regarding their architectural layouts using the pilot schools' drawings obtained from the EKAP (Electronic Public Procurement Platform), which provides architectural drawings of public school buildings in Türkiye. For each pilot region experiencing different climate types, plan diagrams were developed for primary, secondary, and high school buildings, with one representing extremely hot conditions and another depicting extremely cold conditions. Secondly, the Mean Absolute Deviation Percentage (MDAP) analysis [54] was utilised to evaluate the degree of overlapping among these designs. This analysis revealed the extent to which the sizes of schools, particularly in spaces such as classrooms and corridors, varied in their architectural design.

The second hypothesis was whether the climate responsiveness of educational buildings in Türkiye is insufficient to meet the specific needs of students in varying climatic zones. In order to test this hypothesis, accessible parameters in the architectural drawings obtained from the EKAP platform were considered as indicators of climate-responsive building design. These parameters were insulation material and thickness, shading elements, building orientation, window and floor area ratio (WFR), and window and wall area ratio (WWR). The examination focused on primary, secondary, and high school buildings located in extremely hot and cold pilot cities representing each climate type.

Afterwards, the parameters were assessed against the guideline values specified for that region. Orientation, shading elements, and window-to-floor areas (WFR) of classrooms were evaluated using the guidelines prepared by the Ministry of National Education [55]. The suitability of insulation materials was assessed based on degree day regions [56]. Furthermore, window-to-wall areas (WWR) and window-to-floor areas (WFR) [57] were analysed based on the optimal values provided in the literature. In the final stage, the discussion focused on whether a lack of climate responsiveness in educational buildings negatively impacts student health and well-being, drawing on the findings from Hypotheses 1 and 2. The subsequent stage of this study, which is not included in this manuscript, will focus on real-world applications, anticipating that the design of typical buildings in different climates will lead to unequal learning environments, as indicated by both students' feedback and measurement results. In this stage, specific schools in various climates will be visited, and students' comfort levels and cognitive performance in that specific environment will be tested, considering instantaneous environmental parameters such as daylight, temperature, noise level, etc.

4. Results

This study explores the typological similarities and climate responsiveness of school designs across Türkiye's diverse climatic regions, explicitly examining how these designs adapt to local environmental conditions. In addition, it addresses the need for equality among students whose learning environments are influenced by varying climates and the challenges they encounter.

By understanding these adaptations, the research aims to contribute to more equitable educational experiences for all students, regardless of their geographic and climatic contexts.

4.1. Determination of pilot cities

The Köppen climate classification evaluated Türkiye's diverse climatic regions by analysing average, maximum, and minimum temperatures. The study examined variations among these categories, presenting results through a series of graphs ranging from broad to specific insights. **Figure 2** shows that the mean annual temperature in Türkiye varies significantly, from approximately 6°C in the eastern provinces to 18°C in the southern coastal regions, with middle areas falling in between. **Figure 3** illustrates that average maximum temperatures can exceed 40°C in southeastern provinces like Şanlıurfa during the summer, while northern coastal areas experience temperatures of 30°C or lower. Conversely, **Figure 4** indicates that average minimum temperatures can drop to -15°C in eastern provinces such as Erzurum during winter, whereas western and coastal regions rarely fall below 5°C. These graphs highlight Türkiye's climatic diversity, aiding in the selection of pilot provinces, Şanlıurfa and Erzurum, representing extreme heat and cold, respectively, to assess the adaptability of school designs to local climates.

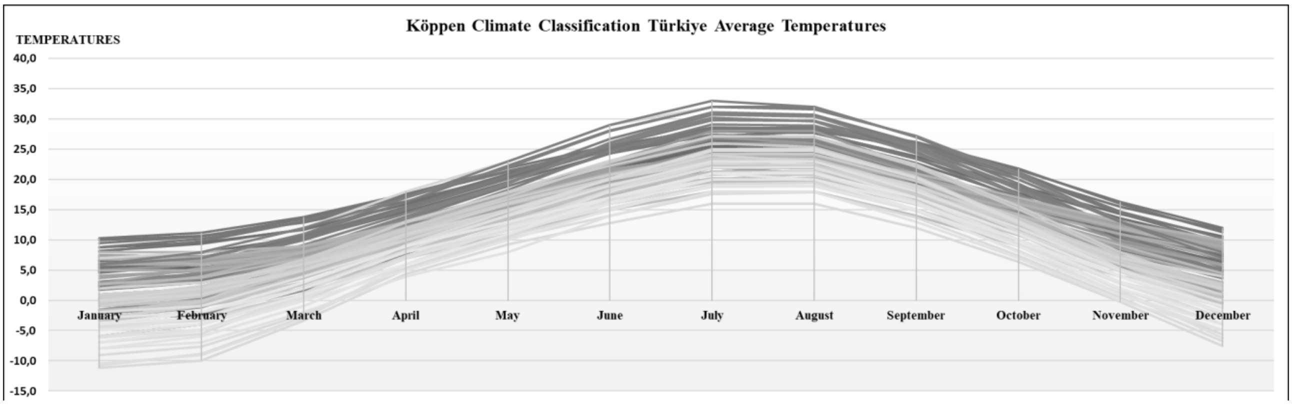


Figure 2. Köppen Climate Classification Türkiye Average Temperatures

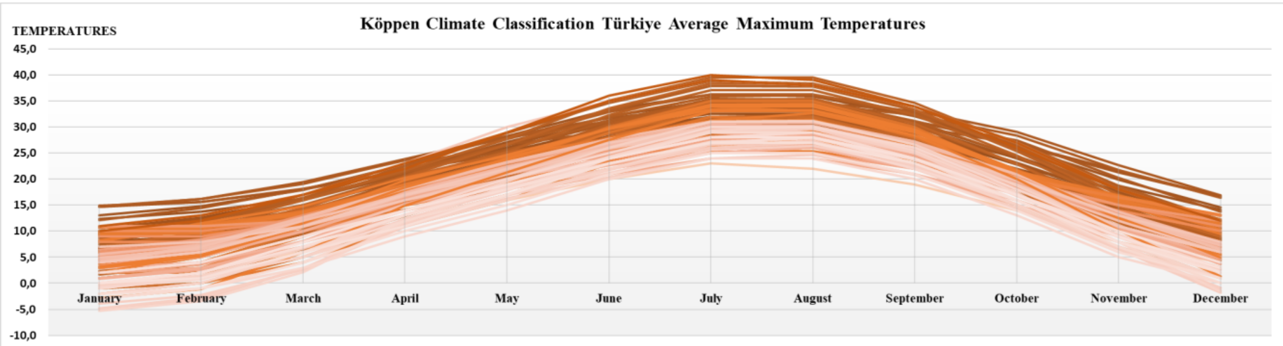


Figure 3. Köppen Climate Classification Türkiye Average Maximum Temperatures

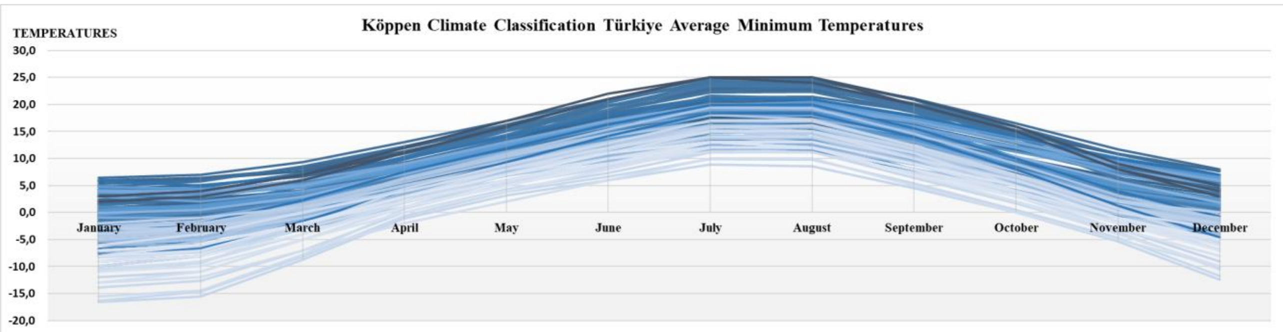


Figure 4. Köppen Climate Classification Türkiye Average Minimum Temperatures

As illustrated in the graphs, temperature differences within a single province in Türkiye can range between 15°C and 20°C even during the same month, underscoring the inadequacy of relying on typological similarity for such diverse climatic conditions. The Köppen climate classification categorises climate groups using a three-letter system.

The first letter identifies the general climate type: A (Equatorial Region), B (Arid Region), C (Warm Temperate Region), D (Snow Region), and E (Polar Region). The second letter specifies precipitation patterns, while the third details temperature variations [58].

The study analysed the average highest and lowest temperatures across the 10 Köppen climate types in Türkiye, along with the overall temperature averages. **Figure 5** indicates that the annual average temperature ranges from 18°C in the colder D climate type to 33°C in the hotter B climate type. **Figure 6** highlights that average summer temperatures exceed 40°C in southeastern provinces like Şanlıurfa, whereas other provinces typically see peaks below 30°C. In contrast, **Figure 7** illustrates that average lows can drop to -17°C or lower in eastern provinces such as Ardahan, while in other areas like Ceylanpınar, winter temperatures rarely fall below 5°C. These numerical variations were essential for identifying pilot cities where specific climate types were most prominent. The findings are presented graphically to offer a more precise visual representation of the significant climate changes across Türkiye.

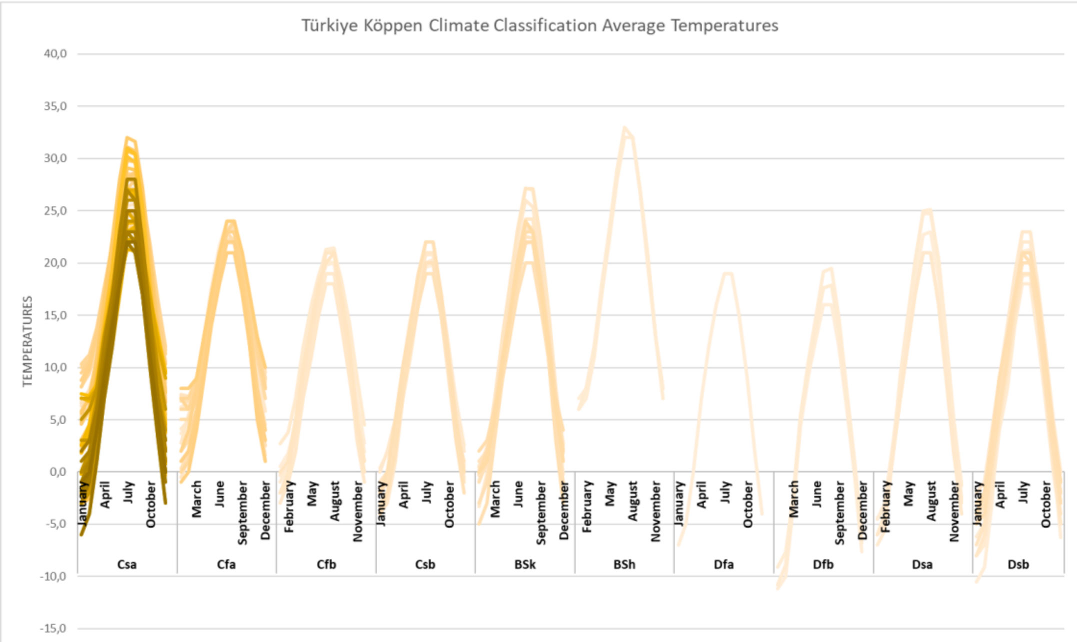


Figure 5. Türkiye Köppen Climate Classification Average Temperatures

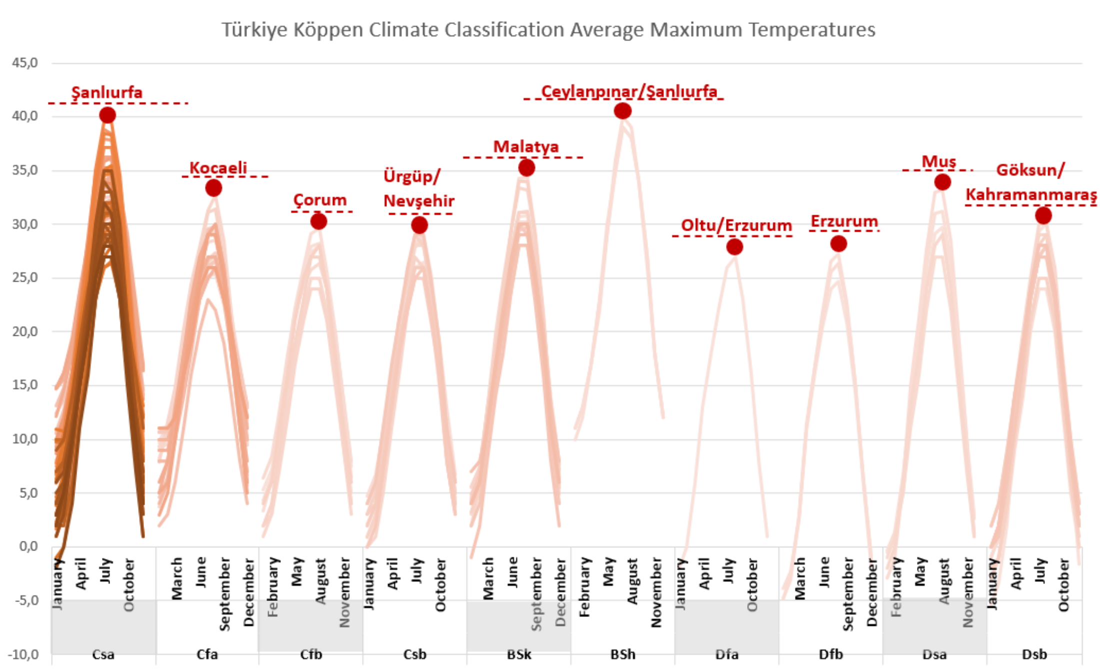


Figure 6. Türkiye Köppen Climate Classification Average Maximum Temperatures

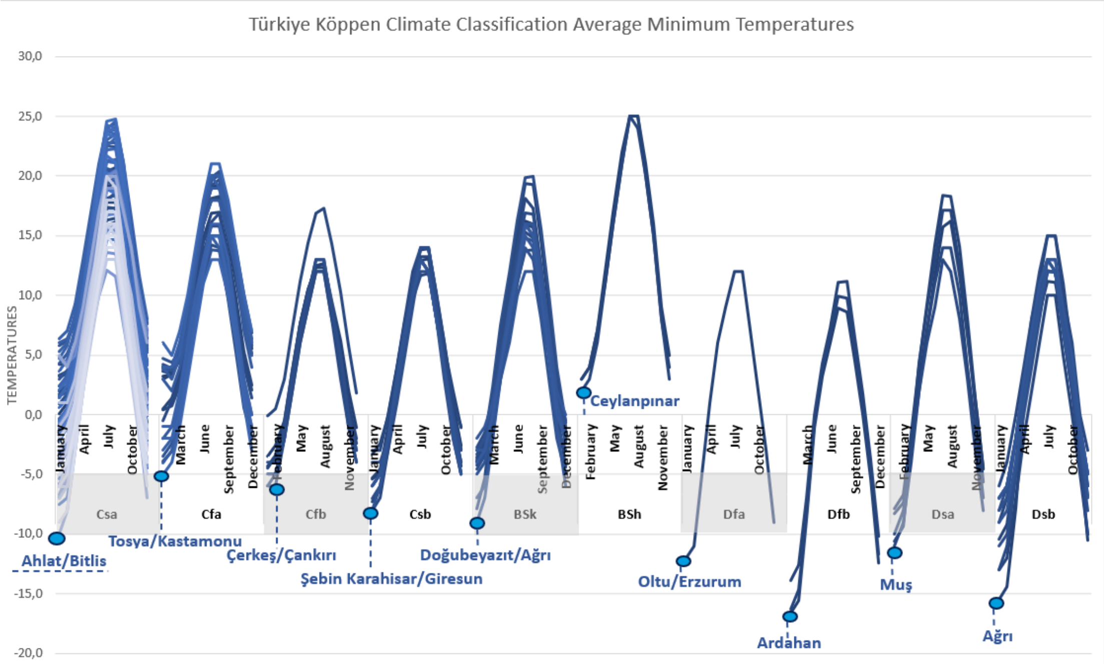
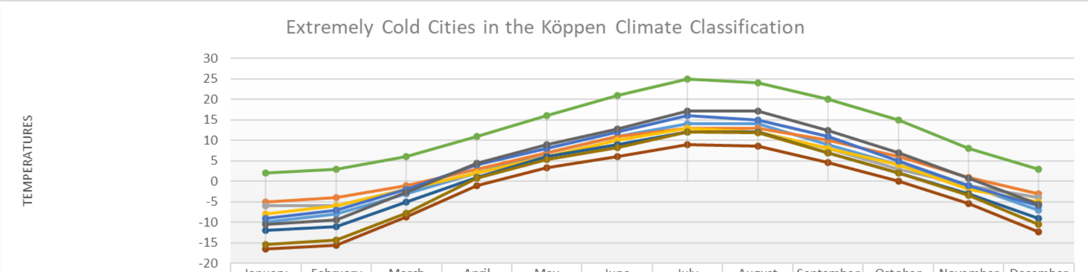


Figure 7. Türkiye Köppen Climate Classification Average Minimum Temperatures

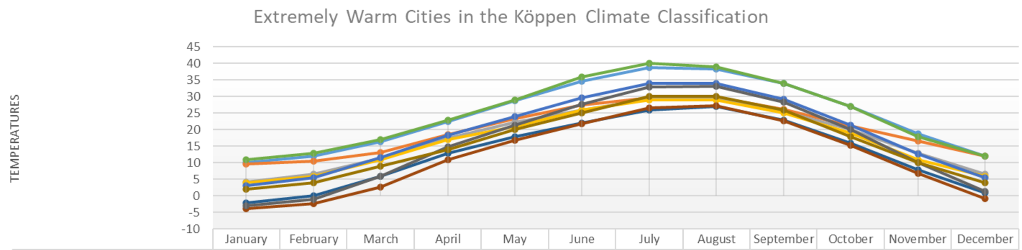
In the context of the Köppen climate classification, the climate types of Türkiye, along with the differences between them and the extreme hot and cold pilot cities associated with each type, have been analyzed. The coldest pilot cities, represented in **Figure 8**, include Ceylanpınar and Ardahan, where average winter temperatures range from 2°C to -16°C. In contrast, the warmest pilot cities, depicted in **Figure 9**, experience summer temperatures often reaching between 25°C and 35°C, with extreme highs approaching 40°C. These significant differences highlight the inadequacy of typologically designed educational structures in providing equitable learning environments across regions. For example, schools in Ardahan may struggle to maintain thermal comfort during harsh winters, while those in Şanlıurfa face challenges in cooling during the intense summer heat. This inability to adapt to diverse climatic conditions emphasizes the urgent need for climate-responsive design tailored to the specific environmental demands of each region.



	January	February	March	April	May	June	July	August	September	October	November	December
Csa Ahlat/ Bitlis	-10	-8	-3	2	7	11	14	14	9	4	-1	-7
Cfa Tosya/Kastamonu	-5	-4	-1	3	7	11	13	13	10	6	1	-3
Cfb Çerkeş/Çankırı	-6	-6	-2	2	6	9	12	12	8	3	-1	-4
Csb Şebin Karahisar/Giresun	-8	-6	-2	2	6	10	13	12	8	4	-2	-5
BSk Doğubeyazıt/Ağrı	-9	-7	-2	4	8	12	16	15	11	5	-1	-6
BSh Ceylanpınar/Şanlıurfa	2	3	6	11	16	21	25	24	20	15	8	3
Dfa Oltu/Erzurum	-12	-11	-5	1	6	9	12	12	7	2	-3	-9
Dfb Ardahan	-16,6	-15,6	-8,7	-1,1	3,2	6	8,9	8,6	4,5	0	-5,4	-12,4
Dsa Muş	-10,6	-9,4	-2,7	4,4	8,9	12,8	17,1	17,1	12,4	7	0,7	-5,6
Dsb Ağrı	-15,5	-14,4	-7,8	0,7	5,3	8,2	12,1	11,9	7	2	-3,5	-10,5

AVERAGE COLDEST TEMPERATURES OF PILOT CITIES OF KOPPEN CLIMATE TYPES

Figure 8. The differences observed among the coldest pilot cities



	January	February	March	April	May	June	July	August	September	October	November	December
Csa Şanlıurfa	10	12	16,4	22,4	28,8	34,7	38,8	38,4	34	27,1	18,8	12,1
Cfa Kocaeli	9,7	10,6	13,2	18,5	23,3	27,5	29,6	29,8	26,2	21,1	16,5	12
Cfb Çorum	4,3	6,5	11,4	17,5	22,2	26	29,1	29,6	25,6	20	13	6,5
Csb Ürgüp/Nevşehir	4	6	11	17	21	26	29	29	25	19	11	6
BSk Malatya	3,2	5,6	11,6	18,4	24	29,6	34	34	29,2	21,4	12,6	5,5
BSh Ceylanpınar/Şanlıurfa	11	13	17	23	29	36	40	39	34	27	18	12
Dfa Oltu/Erzurum	-2	0	6	13	18	22	26	27	23	16	8	1
Dfb Erzurum	-3,9	-2,3	2,6	11,0	16,9	21,8	26,6	27,3	22,7	15,2	6,9	-0,9
Dsa Muş	-2,9	-1,1	6	14,9	21,3	27,6	33	33,2	28,4	20	10,1	1,3
Dsb Göksun/Kahramanmaraş	2	4	9	14	20	25	30	30	26	18	10	4

AVERAGE WARMEST TEMPERATURES OF PILOT CITIES OF KOPPEN CLIMATE TYPES

Figure 9. The differences observed among the warmest pilot cities

4.1. Hypothesis 1: Identification of typological similarity

The first hypothesis evaluated the degree of uniformity in school designs across pilot cities with varying climate types through an overlap analysis of plan schemes. The results indicated a high level of typological similarity among schools in these regions. To determine whether schools in pilot provinces with extreme climate values were designed as uniform projects, detailed data were collected from EKAP. Plan schemes, building sizes, and the percentage overlap of spaces for primary, secondary, and high school projects of the same quality were analysed in a typological context using MADP analysis.

The findings revealed significant overlap: primary schools exhibited a 69% typological overlap, secondary schools had the highest at 92%, and high schools also showed a 69% overlap. Furthermore, variations in building sizes across different provinces were minimal, with differences averaging only 5-8% between regions.

These results demonstrate that educational buildings are predominantly uniform in design despite being situated in provinces with distinct climatic conditions. For example, schools in Erzurum (cold snow climate, D) and Şanlıurfa (hot arid climate, B) share nearly identical layouts and building dimensions, highlighting the inadequacy of current typological designs in meeting climate-specific needs.

4.1.1. Plan schemes analysis

4.1.1.1. Primary schools

The analysis of primary school projects in pilot provinces with varying climatic conditions revealed that the plan schemes were predominantly similar and linear. As illustrated in **Figure 10**, most schools followed a linear design, with classrooms and administrative spaces organised along central corridors. For instance, primary schools in Ardahan (climate D) and Şanlıurfa (climate B), representing two extremes in temperature differences, exhibited nearly identical layouts, featuring average corridor widths of 2.5 meters and classroom sizes of approximately 50 square meters. These findings underscore the lack of adaptation to regional climate needs, as the same linear layouts are employed despite significant variations in temperature and environmental conditions between the provinces.

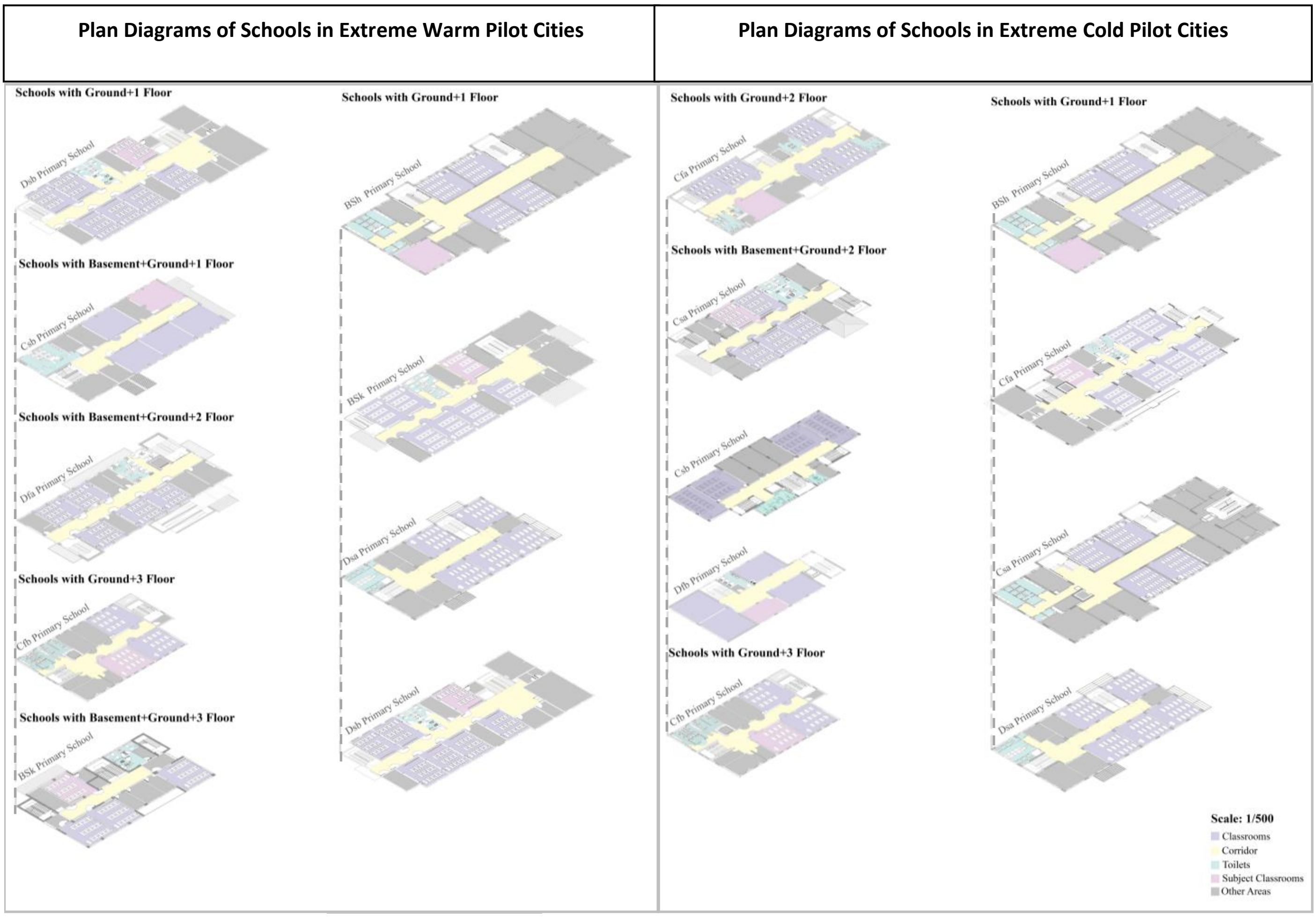


Figure 10. Primary school project plan schemes

4.1.1.2. Secondary schools

Secondly, the analysis of secondary school projects in pilot provinces with varying climate conditions revealed that the layout schemes were predominantly similar and followed a linear pattern, as depicted in **Figure 11**. Notably, a striking resemblance was observed between the designs of secondary and primary schools. For instance, corridor widths and classroom sizes in secondary schools closely align with those in primary schools, averaging 2.5 meters and 50 square meters, respectively. This homogeneity underscores the lack of climate-responsive and user-specific considerations in the design process. The standardised layouts fail to address the unique needs of secondary school users, particularly older students who require differentiated spatial arrangements to enhance their learning environments. Consequently, the findings highlight that secondary schools, much like primary schools, are designed without specific adaptations to their users' diverse climatic and educational needs.

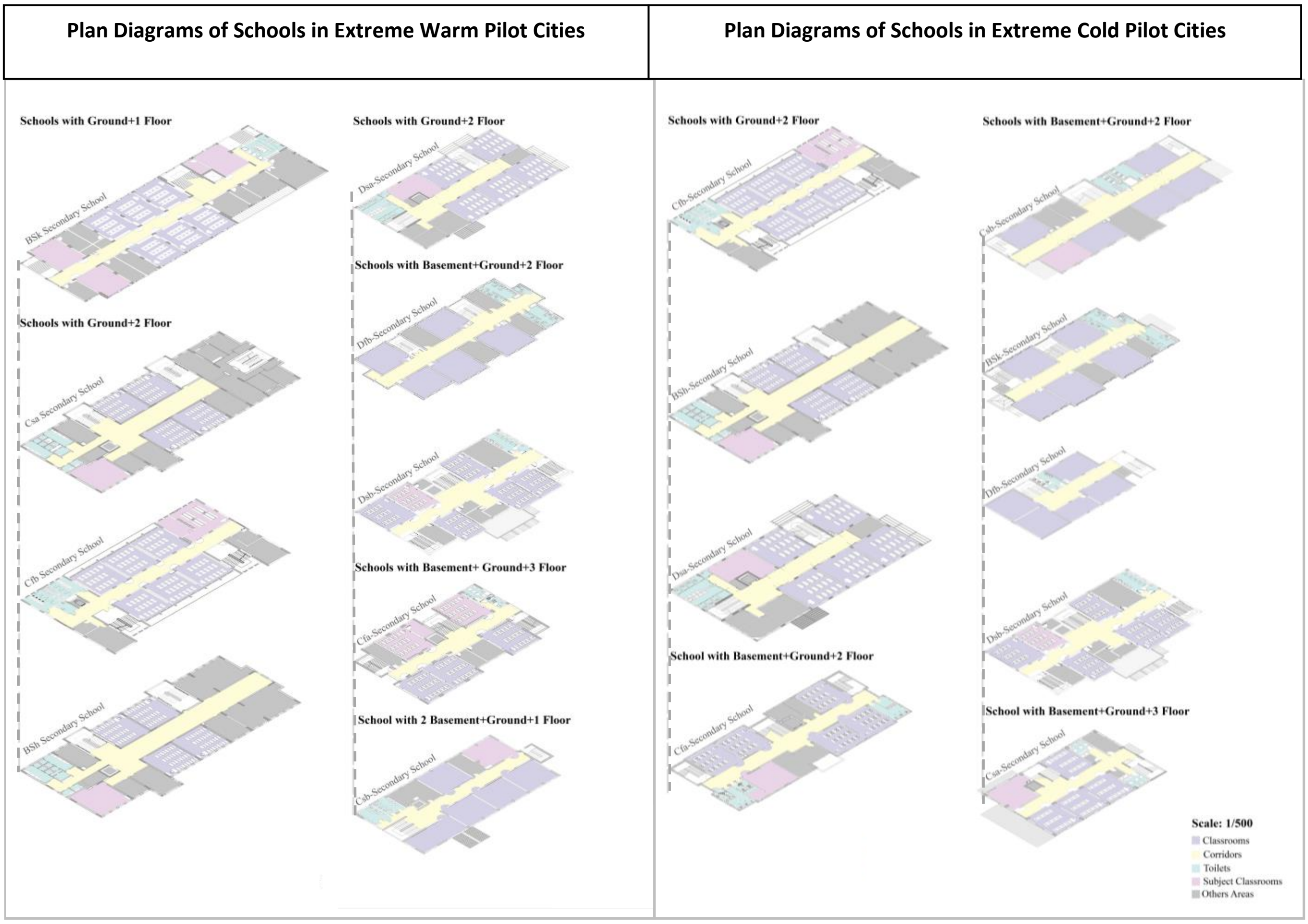


Figure 11. Secondary school project plan schemes

4.1.1.3. High schools

Finally, the analysis of high school projects in pilot provinces with varying climates revealed that the architectural plan schemes displayed a notably similar and predominantly linear design, as illustrated in **Figure 12**. It was emphasised that there was consistent adherence to standard layouts across regions. When comparing the architectural plans of basic educational buildings (primary schools, secondary schools, and high schools), a high degree of similarity was observed, regardless of climate type or user group. In particular, the architectural designs of these schools did not reflect significant adjustments to accommodate the differing needs of user groups. This lack of differentiation becomes especially problematic as the average age of the user groups increases. [59] noted that metabolic rates change with age, directly impacting comfort standards, particularly thermal comfort. For instance, younger students in primary schools may have lower thermal comfort requirements, while older students in high schools need different environmental conditions to maintain comfort and focus. However, the design uniformity across educational structures fails to consider these metabolic and comfort differences, further underscoring the inadequacy of typological designs in providing equitable and climate-responsive learning environments.

Plan Diagrams of Schools in Extreme Warm Pilot Cities	Plan Diagrams of Schools in Extreme Cold Pilot Cities

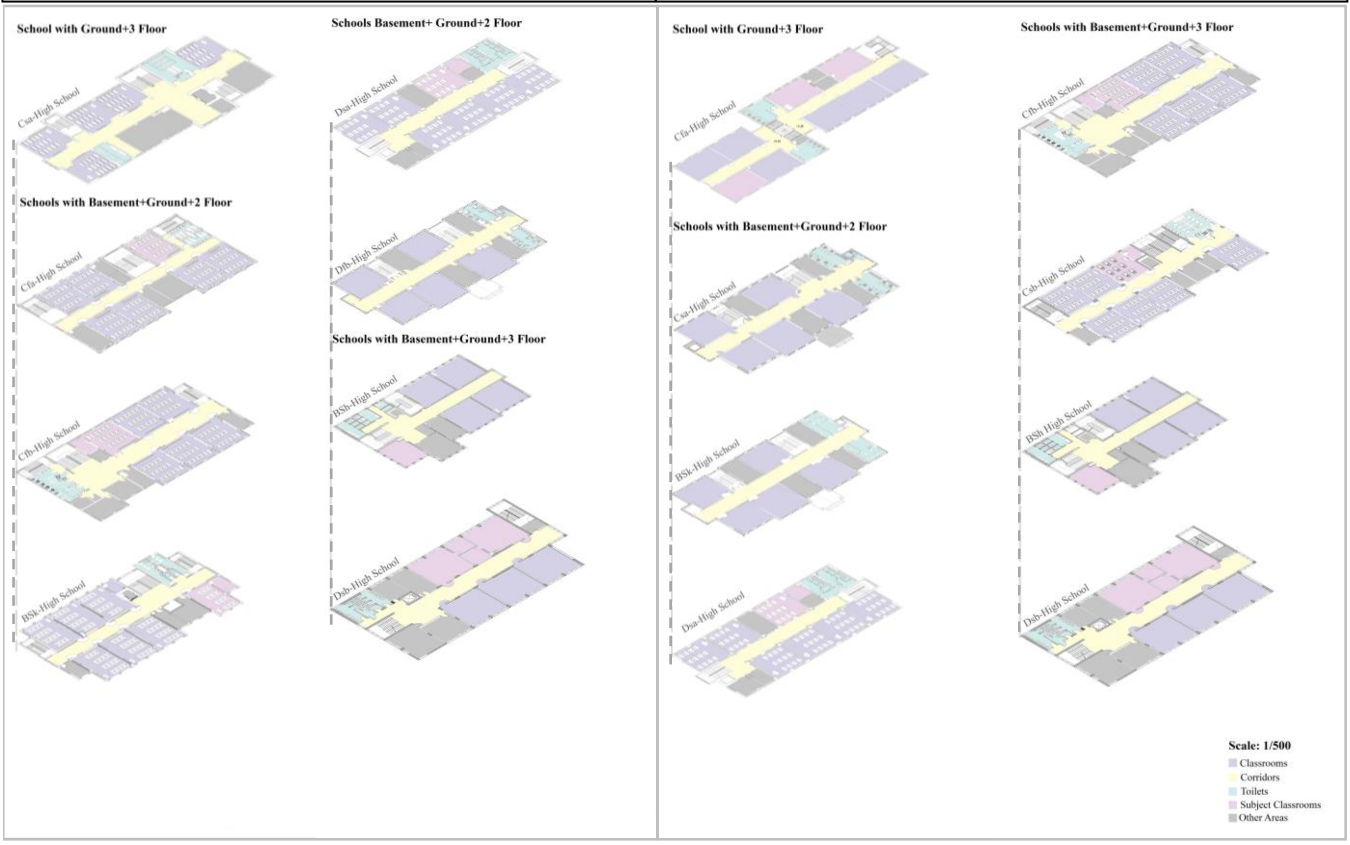


Figure 12. High school project plan schemes

4.2.2. Overlap analysis

The study conducted a comprehensive analysis to evaluate the typological similarity of school architectural designs by calculating the overlap percentages of various spaces. The classroom, being the primary space where students spend most of their time and crucial for cognitive performance, was prioritised in the analysis. Following the classroom, corridor spaces and other areas were also included in the overlap calculations, providing a thorough understanding of how different spaces in schools compare. As seen in **Table 1**, a significant finding was that middle schools exhibited an impressive 92% overlap in their architectural plans, indicating a strong similarity in design across various middle schools. Additionally, both primary and high schools showed a 69% overlap, highlighting notable similarities in their architectural plans despite differences in educational levels. Furthermore, the MADP value, particularly for classrooms, remained below 5, reflecting minimal differentiation. These results emphasise the importance of considering not only the plan schemes but also the actual spatial configurations when evaluating the typological similarities of schools. The findings indicate that while there are distinct characteristics in school designs, there is a significant level of uniformity, especially among primary, secondary, and high schools, suggesting a need for more climate-responsive and user-specific design approaches.

Table 1. Overlap analysis

	Primary School	Secondary School	High School
MADP	Classrooms: 4,6 Corridors: 3,4 Other Areas: 6,6	Classrooms: 3,9 Corridors: 2,4 Other Areas: 3,9	Classrooms: 4,1 Corridors: 5,5 Other Areas: 8,2
Standard Deviation	Classrooms: 6,6 Corridors: 4,9 Other Areas: 9,4	Classrooms: 5,0 Corridors: 3,0 Other Areas: 4,7	Classrooms: 5,3 Corridors: 7,7 Other Areas: 12,5
Overlapping Percentage	**69%**	**92%**	**69%**

The analysis revealed that the architectural plans of primary, secondary, and high schools across various climate types in Türkiye exhibit a high degree of similarity. Notably, the study confirmed significant typological similarity among these educational structures, with a 69% overlap for primary and high schools and an impressive 92% for secondary schools. This indicates that the designs remain largely uniform despite differing climatic conditions. Moreover, there is no substantial variation in the architectural designs of these schools across different user groups. Therefore, it is crucial to emphasise the need for schools to be designed in a manner that adapts to the evolving needs of their users.

4.3. Hypothesis 2: Identification of climate responsive design

The second hypothesis of this study posits that the climate responsiveness of educational buildings in Türkiye is insufficient to meet the specific needs of students across varying climatic zones. To test this hypothesis, accessible parameters from the EKAP platform, such as insulation material and thickness, shading elements, building orientation, window floor area ratio (WFR), and window wall area ratio (WWR), were considered as indicators of climate-responsive design. These parameters were examined in primary, secondary, and high school buildings located in regions characterised by extremely hot and cold climates. Subsequently, these parameters were evaluated against the guideline values specified for each region.

4.3.1. Insulation

Insulation was analysed due to its crucial role in ensuring thermal comfort within buildings [60]. The window floor area ratio was also considered, as it impacts both thermal and lighting comfort in relation to the depth and façade of a space [61]. The window wall ratio is another important parameter influencing comfort, particularly through façade design and orientation, and should vary according to climate [62]. Building orientation inherently affects all these window and façade ratios [63]. Additionally, shading elements are essential design features that must be integrated into façade design to meet climate requirements [64]. Upon examining the insulation parameters of primary school projects (**Table 2**), secondary school projects (**Table 3**), and high school projects (**Table 4**), it becomes evident that, despite attention to insulation, there is a noticeable tendency to overuse materials, which adversely impacts cost-effectiveness. For instance, primary schools typically employ 8 cm of Stone Wool wall insulation thickness in 3rd Degree day zones, while the recommended insulation for these zones is only 5 cm, suggesting potential material overuse. Similarly, secondary schools utilise 10 cm of XPS wall insulation, whereas the recommended insulation for 4th Degree day zones is just 6 cm. In high school projects, insulation also tends to exceed recommended parameters, with instances of using up to 5 cm of Stone Wool when only 4 cm of insulation is necessary for 2nd Degree zones. This overuse can result in unnecessary costs without significantly enhancing thermal comfort.

Table 2. Investigation of insulation parameters of primary schools

PRIMARY SCHOOL TYPE PROJECTS						
Köppen Climate Classification	Köppen Climate Classification Codes	MEB Climate Classification	Degree Day Regions	Existing Insulation	Recommended Insulation	Control
COLD	**Csa** Van	Hot Dry	4. Degree	Wall: 5 cm Rock Wool	Wall: 6 cm	X
	Cfa Tosya/Kastamonu	Hot Humid	3. Degree	Wall: 5 cm EPS	Wall: 5 cm	✓
	Cfb Kastamonu	Hot Humid	4. Degree	Wall: 5 cm Rock Wool	Wall: 6 cm	X
	Csb Sivas	Hot Dry	4. Degree	Wall: 7 cm EPS	Wall: 6 cm	✓✓
	BSk Konya	Cold	3. Degree	Wall: 8 cm Rock Wool	Wall: 5 cm	✓✓
	BSh Ceylanpınar/Şanlıurfa	Hot Dry	2. Degree	Wall : 5 cm Glass Wool	Wall: 4 cm	✓✓
	Dfb Ardahan	Cold	4. Degree	Wall: 5 cm EPS	Wall: 6 cm	X
	Dsa Muş	Cold	4. Degree	Wall: 6 cm Rock Wool	Wall: 6 cm	✓
	Dsb Ağrı	Cold	4. Degree	Wall: 3 cm XPSX5 cm Rock Wool	Wall: 6 cm	✓✓
WARM	**Csa** Şanlıurfa	Hot Dry	2. Degree	Wall: 4 cm XPS	Wall: 4 cm	✓
	Cfa Afyonkarahisar	Hot Humid	3. Degree	Wall: 6 cm EPS	Wall: 5 cm	✓✓
	Cfb Kastamonu	Hot Humid	4. Degree	Wall: 5 cm Rock Wool	Wall: 6 cm	X
	Csb Gümüşhane	Hot Dry	4. Degree	Wall: 7 cm XPS	Wall: 6 cm	✓✓
	BSk Malatya	Cold	3. Degree	Wall: 5 cm Rock Wool	Wall: 5 cm	✓
	BSh Ceylanpınar/Şanlıurfa	Hot Dry	2. Degree	Wall: 5 cm Glass Wool	Wall: 4 cm	✓✓
	Dfb Erzurum	Cold	4. Degree	Wall: 8 cm Rock Wool	Wall: 6 cm	✓✓
	Dsa Muş	Cold	4. Degree	Wall: 6 cm Rock Wool	Wall: 6 cm	✓
	Dsb Ağrı	Cold	4. Degree	Wall: 3 cm XPSX5 cm Rock Wool	Wall: 6 cm	✓✓

Table 3. Investigation of insulation parameters of secondary schools

SECONDARY SCHOOL TYPE PROJECTS						
Köppen Climate Classification	Köppen Climate Classification Codes	MEB Climate Classification	Degree Day Regions	Existing Insulation	Recommended Insulation	Control
COLD	**Csa** Van	Hot Dry	4. Degree	Wall: 5 cm Rock Wool	Wall: 6 cm	X
	Cfa Tosya/Kastamonu	Hot Humid	3. Degree	Wall: 5 cm EPS	Wall: 5 cm	✓
	Cfb Kastamonu	Hot Humid	4. Degree	Wall: 6 cm Rock Wool	Wall: 6 cm	✓
	Csb Sivas	Hot Dry	4. Degree	Wall: 7 cm XPS	Wall: 6 cm	✓✓
	BSk Konya	Cold	3. Degree	Wall: 5 cm XPS	Wall: 5 cm	✓
	BSh Ceylanpınar/Şanlıurfa	Hot Dry	2. Degree	Wall: 5 cm Glass Wool	Wall: 4 cm	✓✓
	Dfb Ardahan	Cold	4. Degree	Wall: 5 cm EPS	Wall: 6 cm	X
	Dsa Muş	Cold	4. Degree	Wall: 6 cm Rock Wool	Wall: 6 cm	✓
	Dsb Ağrı	Cold	4. Degree	Wall: 8 cm Rock Wool	Wall: 6 cm	✓✓
WARM	**Csa** Şanlıurfa	Hot Dry	2. Degree	Wall: 5 cm Glass Wool	Wall: 4 cm	✓✓
	Cfa Afyonkarahisar	Hot Humid	3. Degree	Wall: 6 cm EPS	Wall: 5 cm	✓✓
	Cfb Kastamonu	Hot Humid	4. Degree	Wall: 6 cm Rock Wool	Wall: 6 cm	✓
	Csb Gümüşhane	Hot Dry	4. Degree	Wall: 10 cm XPS	Wall: 6 cm	✓✓
	BSk Malatya	Cold	3. Degree	Wall: 5 cm Rock Wool	Wall: 5 cm	✓
	BSh Ceylanpınar/Şanlıurfa	Hot Dry	2. Degree	Wall: 5 cm Glass Wool	Wall: 4 cm	✓✓
	Dfb Erzurum	Cold	4. Degree	Wall: 5 cm Rock Wool	Wall: 6 cm	X
	Dsa Muş	Cold	4. Degree	Wall: 6 cm Rock Wool	Wall: 6 cm	✓
	Dsb Ağrı	Cold	4. Degree	Wall: 8 cm Rock Wool	Wall: 6 cm	✓✓

Table 4. Investigation of insulation parameters of high schools

HIGH SCHOOL TYPE PROJECTS						
Köppen Climate Classification	Köppen Climate Classification Codes	MEB Climate Classification	Degree Day Regions	Existing Insulation	Recommended Insulation	Control
COLD	**Csa** Van	Hot Dry	4. Degree	Wall: 5 cm XPS	Wall: 6 cm	X
	Cfa Tosya/Kastamonu	Hot Humid	3. Degree	Wall: 6 cm Rock Wool	Wall: 5 cm	✓✓
	Cfb Kastamonu	Hot Humid	4. Degree	Wall: 6 cm Rock Wool	Wall: 6 cm	✓
	Csb Sivas	Hot Dry	4. Degree	Wall: 5 cm XPS	Wall: 6 cm	X
	BSk Konya	Cold	3. Degree	Wall: 5 cm XPS	Wall: 5 cm	✓
	BSh Ceylanpınar/Şanlıurfa	Hot Dry	2. Degree	Wall: 5 cm Rock Wool	Wall: 4 cm	✓✓
	Dsa Muş	Cold	4. Degree	Wall: 6 cm Rock Wool	Wall: 6 cm	✓
	Dsb Ağrı	Cold	4. Degree	Wall: 8 cm Rock Wool	Wall: 6 cm	✓✓
WARM	**Csa** Şanlıurfa	Hot Dry	2. Degree	Wall: 5 cm Rock Wool	Wall: 4 cm	✓✓
	Cfa Afyonkarahisar	Hot Humid	3. Degree	Wall: 6 cm EPS	Wall: 5 cm	✓✓
	Cfb Kastamonu	Hot Humid	4. Degree	Wall: 6 cm Rock Wool	Wall: 6 cm	✓
	BSk Malatya	Cold	3. Degree	Wall: 6 cm Rock Wool	Wall: 5 cm	✓✓
	BSh Ceylanpınar/Şanlıurfa	Hot Dry	2. Degree	Wall: 5 cm Rock Wool	Wall: 4 cm	✓✓
	Dfb Erzurum	Cold	4. Degree	Wall: 5 cm Rock Wool	Wall: 6 cm	X
	Dsa Muş	Cold	4. Degree	Wall: 6 cm Rock Wool	Wall: 6 cm	✓
	Dsb Ağrı	Cold	4. Degree	Wall: 8 cm Rock Wool	Wall: 6 cm	✓✓

4.3.2. Orientation and shading elements

It is evident that shading elements and orientation parameters are largely overlooked in various educational projects. In the primary school projects (**Table 5**), it is particularly notable that the shading elements mandated by the Ministry of National Education are absent in 85% of the analysed schools located in hot and dry regions, such as Şanlıurfa and Van. Additionally, none of the 18 primary schools examined implemented orientations correctly, with an average deviation of 15° from the recommended angles. A similar trend is observed in secondary school projects (**Table 6**), where 78% of the schools lacked appropriate shading elements, and the orientation was incorrectly implemented in 12 out of 18 schools, deviating by an average of 12° from optimal orientations. In contrast, high school projects (**Table 7**) demonstrate a more favourable situation, as shading elements were present in 3 out of 5 schools in the hot and dry region, where they are required, indicating a positive shift toward climate-responsive design. However, even in these cases, the average deviation of orientation from the recommended angles is 10°, suggesting that further improvements are necessary across all levels of education.

Table 5. Investigation of shading element and orientation parameters of primary schools

Köppen Climate Classification	Köppen Climate Classification Codes	MEB Climate Classification	Shading Element (Existing)	Shading Element (Recommended)	Shading Element (Control)	Orientation (Existing)	Orientation (Recommended)	Orientation (Control)
COLD	**Csa** Van	**Hot Dry**	-	Obligatory	X	5° Southeast	25° South-Southeast	X
	Cfa Tosya/Kastamonu	**Hot Humid**	EPS Jamb	Recommended	✓	40° Southwest	5° South-Southeast	X
	Cfb Kastamonu	**Hot Humid**	-	Recommended	X	49° Southwest	5° South-Southeast	X
	Csb Sivas	**Hot Dry**	-	Obligatory	X	23° Southwest	25° South-Southeast	X
	BSk Konya	**Cold**	-	Not Necessary	✓	9° Southeast	12° South-Southeast	X
	BSh Ceylanpınar/Şanlıurfa	**Hot Dry**	-	Obligatory	X	27° Southeast	25° South-Southeast	X
	Dfb Ardahan	**Cold**	Jamb	Not Necessary	X	37° Southwest	12° South-Southeast	X
	Dsa Muş	**Cold**	EPS Jamb	Not Necessary	X	46° Southeast	12° South-Southeast	X
	Dsb Ağrı	**Cold**	-	Not Necessary	✓	45° Southwest	12° South-Southeast	X
WARM	**Csa** Şanlıurfa	**Hot Dry**	-	Obligatory	X	5° Southeast	25° South-Southeast	X
	Cfa Afyonkarahisar	**Hot Humid**	EPS Jamb	Recommended	✓	33° Southwest	5° South-Southeast	X
	Cfb Kastamonu	**Hot Humid**	-	Recommended	X	49° Southwest	5° South-Southeast	X
	Csb Gümüşhane	**Hot Dry**	-	Obligatory	X	76° Southeast	25° South-Southeast	X
	BSk Malatya	**Cold**	EPS Jamb	Not Necessary	X	46° Southeast	12° South-Southeast	X
	BSh Ceylanpınar/Şanlıurfa	**Hot Dry**	-	Obligatory	X	27° Southeast	25° South-Southeast	X
	Dfb Erzurum	**Cold**	EPS Jamb	Not Necessary	X	2° Southwest	12° South-Southeast	X
	Dsa Muş	**Cold**	EPS Jamb	Not Necessary	X	46° Southeast	12° South-Southeast	X
	Dsb Ağrı	**Cold**	-	Not Necessary	✓	45° Southwest	12° South-Southeast	X

Table 6. Investigation of shading element and orientation parameters of secondary schools

Köppen Climate Classification	Köppen Climate Classification Codes	MEB Climate Classification	Shading Element (Existing)	Shading Element (Recommended)	Shading Element (Control)	Orientation (Existing)	Orientation (Recommended)	Orientation (Control)
COLD	**Csa** Van	Hot Dry	-	Obligatory	X	57° Southwest	25° South-Southeast	X
	Cfa Tosya/Kastamonu	Hot Humid	EPS Jamp	Recommended	✓	24° Southeast	5° South-Southeast	X
	Cfb Kastamonu	Hot Humid	EPS Jamp	Recommended	✓	75° Southeast	5° South-Southeast	X
	Csb Sivas	Hot Dry	-	Obligatory	X	5° Southwest	25° South-Southeast	X
	BSk Konya	Cold	Jamp	Not Necessary	X	6° Southeast	12° South-Southeast	X
	BSh Ceylanpınar/Şanlıurfa	Hot Dry	-	Obligatory	X	4° Southeast	25° South-Southeast	X
	Dfb Ardahan	Cold	-	Not Necessary	✓	74° Southeast	12° South-Southeast	X
	Dsa Muş	Cold	Jamp	Not Necessary	X	North-South	12° South-Southeast	X
	Dsb Ağrı	Cold	Jamp	Not Necessary	X	15° Southeast	12° South-Southeast	X
WARM	**Csa** Şanlıurfa	Hot Dry	-	Obligatory	X	15° Southeast	25° South-Southeast	X
	Cfa Afyonkarahisar	Hot Humid	EPS Jamp	Recommended	✓	10° Southeast	5° South-Southeast	X
	Cfb Kastamonu	Hot Humid	EPS Jamp	Recommended	✓	75° Southeast	5° South-Southeast	X
	Csb Gümüşhane	Hot Dry	-	Obligatory	X	7° Southwest	25° South-Southeast	X
	BSk Malatya	Cold	-	Not Necessary	✓	2° Southwest	12° South-Southeast	X
	BSh Ceylanpınar/Şanlıurfa	Hot Dry	-	Obligatory	X	4° Southeast	25° South-Southeast	X
	Dfb Erzurum	Cold	Jamp	Not Necessary	X	14° Southwest	12° South-Southeast	X
	Dsa Muş	Cold	Jamp	Not Necessary	X	North-South	12° South-Southeast	X
	Dsb Ağrı	Cold	Jamp	Not Necessary	X	15° Southeast	12° South-Southeast	X

Table 7. Investigation of shading element and orientation parameters of high schools

Köppen Climate Classification	Köppen Climate Classification Codes	MEB Climate Classification	Shading Element (Existing)	Shading Element (Recommended)	Shading Element (Control)	Orientation (Existing)	Orientation (Recommended)	Orientation (Control)
COLD	**Csa** Van	Hot Dry	Jamp	Obligatory	✓✓	30° Southwest	25° South-Southeast	X
	Cfa Tosya/Kastamonu	Hot Humid	-	Recommended	X	Vaziyet yok	5° South-Southeast	X
	Cfb Kastamonu	Hot Humid	EPS Jamp	Recommended	✓	10° Southwest	5° South-Southeast	X
	Csb Sivas	Hot Dry	XPS Jamp	Obligatory	✓✓	North-South	25° South-Southeast	X
	BSk Konya	Cold	Jamp	Not Necessary	X	9° Southwest	12° South-Southeast	X
	BSh Ceylanpınar/Şanlıurfa	Hot Dry	-	Obligatory	X	20° Southwest	25° South-Southeast	X
	Dsa Muş	Cold	-	Not Necessary	✓	44° Southeast	12° South-Southeast	X
	Dsb Ağrı	Cold	Jamp	Not Necessary	X	9° Southwest	12° South-Southeast	X
WARM	**Csa** Şanlıurfa	Hot Dry	Jamp	Obligatory	✓✓	19° Southwest	25° South-Southeast	X
	Cfa Afyonkarahisar	Hot Humid	-	Recommended	X	24° Southwest	5° South-Southeast	X
	Cfb Kastamonu	Hot Humid	EPS Jamp	Recommended	✓	10° Southwest	5° South-Southeast	X
	BSk Malatya	Cold	EPS Jamp	Not Necessary	X	17° Southeast	12° South-Southeast	X
	BSh Ceylanpınar/Şanlıurfa	Hot Dry	-	Obligatory	X	20° Southwest	25° South-Southeast	X
	Dfb Erzurum	Cold	Jamp	Not Necessary	X	8° Southeast	12° South-Southeast	X
	Dsa Muş	Cold	-	Not Necessary	✓	44° Southeast	12° South-Southeast	X
	Dsb Ağrı	Cold	Jamp	Not Necessary	X	9° Southwest	12° South-Southeast	X

4.3.3. Window-to-wall area ratio (WWR)

Regarding the window-to-wall area ratio (WWR) parameter, some harmony is observed in the facades of primary school buildings, with 11 out of 18 schools showing consistent design (**Table 8**). However, there are no instances where every facade is harmonised. In analysing selected classrooms, this lack of compatibility can negatively impact interior comfort conditions. Additionally, it was found that 55.5% of the classrooms are situated on the east and west facades. In secondary schools (**Table 9**), only 7 out of 18 projects—approximately half—were designed in accordance with the recommended ratio, and no classrooms met the appropriate ratio criteria. Furthermore, in secondary school projects, 50% of the schools are also located on the east and west facades. In high school projects (**Table 10**), appropriate values for the WWR are more frequently observed compared to primary and secondary schools. In these projects, at least one facade (13 out of 15) falls within the recommended ratio range in nearly all schools. Another noteworthy observation is that, unlike primary and secondary schools, almost all high school classroom facades (13 out of 15) are oriented toward the south and north.

However, the classroom arrangements do not align with climate zone recommendations, as observed in the primary and secondary schools.

Table 8. Investigation of window-wall area ratio (WWR) parameters of primary school

PRIMARY SCHOOL TYPE PROJECTS		Window-Wall Area Ratio (%)								Sample Classrooms		
Köppen Climate Classification	Köppen Climate Classification Codes	North Facade	Recommended %5-10	South Facade	Recommended %10-22.5	East Facade	Recommended %10-15	West Facade	Recommended %10-15	Orientation	Degree	Control
COLD	Csa Van	8,48	✓	7,58	x	18,18	x	19,3	x	East West	30,6	x
	Cfa Tosya/Kastamonu	5,5	✓	7,2	x	17,2	x	21,4	x	East West	29	x
	Cfb Kastamonu	9,9	✓	2,6	x	17,4	x	23,4	x	East West	28,5	x
	Csb Sivas	15	x	24,8	x	15,8	x	17,3	x	South East West	S: 34,8 E: 28,6 W: 25,1	x
	BSk Konya	0,35	x	4,66	x	28,28	x	23,06	✓	East West	54,83	x
	BSh Ceylanpınar/Şanlıurfa	24,7	x	20,2	✓	5,2	x	5,4	x	North South	35,8	x
	Dfb Ardahan	10,88	x	9,51	x	0,45	x	34,13	x	South North West	S: 20 N: 27 W: 34,29	S ✓ N X W X
	Dsa Muş	16,3	x	19,4	✓	13	✓	3,4	x	North South	30	x
	Dsb Ağrı	0,3	x	2,5	x	25,4	x	20,3	x	East West	39,8	x
		North Facade	Recommended %5-10	South Facade	Recommended %15-22	East Facade	Recommended %10-15	West Facade	Recommended %10-15	Sample Classrooms		
WARM	Csa Şanlıurfa	4,2	x	6,2	x	26,5	x	24	x	East West	36,1	x
	Cfa Afyonkarahisar	2,8	x	0,9	x	28,2	x	24,5	x	East West	26,6	x
	Cfb Kastamonu	9,9	✓	2,6	x	17,4	x	23,4	x	East West	28,5	x
	Csb Gümüşhane	26,1	x	29,4	x	24,6	x	7,8	x	North South	31	x
	BSk Malatya	28,93	✓	32,23	x	16,42	✓	16,85	✓	North South	41,77	x
	BSh Ceylanpınar/Şanlıurfa	24,7	x	20,2	✓	5,2	x	5,4	x	North South	35,8	x
	Dfb Erzurum	21,6	✓	24,82	x	4,94	x	3,29	x	North South	43	x
	Dsa Muş	16,3	x	19,4	✓	13	✓	3,4	x	North South	30	x
	Dsb Ağrı	0,3	x	2,5	x	25,4	x	20,3	x	East West	39,8	x

Table 9. Investigation of window-wall area ratio (WWR) parameters of secondary school

SECONDARY SCHOOL TYPE PROJECTS		Window-Wall Area Ratio (%)								Sample Classrooms		
Köppen Climate Classification	Köppen Climate Classification Codes	North Facade	Recommended %5-10	South Facade	Recommended %10-22.5	East Facade	Recommended %10-15	West Facade	Recommended %10-15	Orientation	Degree	Control
COLD	Csa Van	19	x	16,9	✓	24,3	x	20,9	x	East West	40,4	x
	Cfa Tosya/Kastamonu	5,4	✓	7,2	x	16,9	x	19,5	x	East West	28,6	x
	Cfb Kastamonu	9,6	✓	12,4	✓	26,2	x	25,6	x	East West	44,5	x
	Csb Sivas	3,8	x	3,8	x	21,7	x	28,2	x	East West	35,2	x
	BSk Konya	4,7	x	4,7	x	26	x	27,2	x	East West	43,6	x
	BSh Ceylanpınar/Şanlıurfa	26,4	x	26,1	x	4	x	4,3	x	North South	37,3	x
	Dfb Ardahan	24,2	x	0,4	x	7,3	x	5,9	x	East West North	E - W: 20 N: 34,2	x
	Dsa Muş	3,6	x	10,6	✓	22,9	x	16,3	x	East West	30,9	x
	Dsb Ağrı	28,9	x	24,9	x	2,3	x	4,4	x	North South	42,7	x
		North Facade	Recommended %5-10	South Facade	Recommended %10-22.5	East Facade	Recommended %10-15	West Facade	Recommended %10-15	Sample Classrooms		
WARM	Csa Şanlıurfa	11,1	x	4,3	x	27,2	x	26,3	x	East West	36,1	x
	Cfa Afyonkarahisar	36,8	x	30,8	x	27	x	22,2	x	North South	38,7	x
	Cfb Kastamonu	9,6	✓	12,4	✓	26,2	x	25,6	x	East West	44,5	x
	Csb Gümüşhane	27,4	x	42,1	x	0	x	20,4	x	North South	31	x
	BSk Malatya	31	x	23,7	x	12,3	✓	2,5	x	North South	43,4	x
	BSh Ceylanpınar/Şanlıurfa	26,4	x	26,1	x	4	x	4,3	x	North South	37,3	x
	Dfb Erzurum	22,5	x	23,2	x	6,7	x	6,7	x	North South	N: 37,5 S: 42,2	x
	Dsa Muş	3,6	x	10,6	✓	22,9	x	16,3	x	East West	30,9	x
	Dsb Ağrı	28,9	x	24,9	x	2,3	x	4,4	x	North South	42,7	x

Table 10. Investigation of window-wall area ratio (WWR) parameters of high school

HIGH SCHOOL TYPE PROJECTS		Window-Wall Area Ratio (%)								Sample Classrooms		
Köppen Climate Classification	Köppen Climate Classification Codes	North Facade	Recommended %5-10	South Facade	Recommended %10-22.5	East Facade	Recommended %10-15	West Facade	Recommended %10-15	Orientation	Degree	Control
COLD	**Csa** Van	24,7	X	23,2	✓	6,7	X	6,7	X	North South	**N: 38 S: 42,8**	X
	Cfb Kastamonu	27,6	X	30,7	X	11	✓	3,7	X	North South	**36,3**	X
	Csb Sivas	31,7	X	40,8	X	16,7	X	18,4	X	North South	**41,1**	X
	BSk Konya	6,7	✓	4,7	X	22	X	23,2	X	East West	**E: 36,6 W: 27,4**	X
	BSh Ceylanpınar/Şanlıurfa	25,1	X	37	X	11,4	✓	19	X	North South	**38,9**	X
	Dsa Muş	16	X	18,2	✓	2,5	X	20,1	X	North South	**23,3**	X
	Dsb Ağrı	19,2	X	18,5	✓	4,3	X	11,2	✓	North South	**25,5**	X
		North Facade	Recommended %5-10	South Facade	Recommended %10-22.5	East Facade	Recommended %10-15	West Facade	Recommended %10-15	Sample Classrooms		
WARM	**Csa** Şanlıurfa	22,4	X	16,5	✓	5,7	X	5,7	X	North South	**26**	X
	Cfa Afyonkarahisar	43	X	16,1	✓	3,9	X	3,1	X	North South	**43**	X
	Cfb Kastamonu	27,6	X	30,7	X	11	✓	3,7	X	North South	**36,3**	X
	BSk Malatya	17,5	X	26,2	X	9,6	X	9,6	X	North South	**34**	X
	BSh Ceylanpınar/Şanlıurfa	25,1	X	37	X	11,4	✓	19	X	North South	**38,9**	X
	Dfb Erzurum	7,2	✓	7,1	X	23,7	X	21,5	X	East West	**E: 27 W: 36,6**	X
	Dsa Muş	16	X	18,2	✓	2,5	X	20,1	X	North South	**23,3**	X
	Dsb Ağrı	19,2	X	18,5	✓	4,3	X	11,2	✓	North South	**25,5**	X

4.3.4. Window-to-floor area ratio (WFR)

The window-to-floor area ratio (WFR) shows appropriate values on at least one facade in 7 out of 18 primary schools (**Table 11**). Additionally, 4 out of 18 classrooms meet the appropriate WFR criteria. However, none of the classrooms achieved the 25% rate the Ministry of National Education recommended. In secondary schools (**Table 12**), none of the 18 schools in extremely cold cities fall within the appropriate value range, while 3 schools in extremely hot pilot cities meet the criteria. When examining the optimal WFR value range for classrooms, it is observed that only 6 out of 18 schools achieve this standard. In high school projects (**Table 13**), none of the 15 schools in extremely cold cities meet the appropriate value range, while 3 schools in extremely hot pilot cities comply. The same pattern is evident in classrooms, as the 25% WFR rate recommended by the Ministry of National Education is absent in all high schools, similar to the findings in secondary and primary schools.

Table 11. Investigation of window-floor area ratio (WFR) parameters of primary school

PRIMARY SCHOOL TYPE PROJECTS		Window-Floor Area Ratio (%)								Sample Classrooms			
Köppen Climate Classification	Köppen Climate Classification Codes	North Facade	Recommended %24.5-29	South Facade	Recommended %24.5-29	East Facade	Recommended %20-25	West Facade	Recommended %20-25	Orientation	Degree	Control	MEB Recommended %25
COLD	**Csa** Van	9,9	X	6,5	X	12,7	X	16,3	X	East West	**16,5**	X	X
	Cfa Tosya/Kastamonu	3,6	X	4,7	X	16,3	X	15,9	X	East West	**14,6**	X	X
	Cfb Kastamonu	10,2	X	7,1	X	10,5	X	14,4	X	East West	**13,3**	X	X
	Csb Sivas	16,5	X	14,3	X	15,6	X	17,5	X	South East West	**S: 15,9 E: 16,7 W:16,7**	X	X
	BSk Konya	5,9	X	3,7	X	21,7	✓	21,7	✓	East West	**24**	✓	X
	BSh Ceylanpınar/Şanlıurfa	16,3	X	13,4	X	3,7	X	8,3	X	North South	**16,7**	X	X
	Dfb Ardahan	11,1	X	12,2	X	4,7	X	12,3	X	South North West	**S: 10,9 N: 15,1 W:49,8**	X	X
	Dsa Muş	14	X	13,7	X	11,6	X	20	✓	North South	**14,4**	X	X
	Dsb Ağrı	3,2	X	2,9	X	18,6	X	19	X	East West	**10**	X	X
		North Facade	Recommended %13.5-16.3	South Facade	Recommended %13.5-16.3	East Facade	Recommended %15-20	West Facade	Recommended %15-20	Sample Classrooms			MEB Recommended %25
WARM	**Csa** Şanlıurfa	10	X	11,4	X	15,2	✓	16,2	✓	East West	**16,7**	✓	X
	Cfa Afyonkarahisar	3	X	31,3	X	18,3	✓	18,6	✓	East West	**20**	✓	X
	Cfb Kastamonu	10,2	X	7,1	X	10,5	X	14,4	X	East West	**13,3**	X	X
	Csb Gümüşhane	10,5	X	13,4	✓	13,4	X	4	X	North South	**13,6**	✓	X
	BSk Malatya	24,3	X	19,8	X	14,1	X	14,1	X	North South	**21,6**	X	X
	BSh Ceylanpınar/Şanlıurfa	16,3	X	13,4	X	3,7	X	8,3	X	North South	**16,7**	X	X
	Dfb Erzurum	15,6	✓	20,4	X	4,2	X	2,4	X	North South	**20,3**	X	X
	Dsa Muş	14	X	13,7	X	11,6	X	20	✓	North South	**14,4**	X	X
	Dsb Ağrı	3,2	X	2,9	X	18,6	X	19	X	East West	**10**	X	X

Table 12. Investigation of window-floor area ratio (WFR) parameters of secondary school

SECONDARY SCHOOL TYPE PROJECTS		Window-Floor Area Ratio (%)								Sample Classrooms			
Köppen Climate Classification	Köppen Climate Classification Codes	North Facade	Recommended %24.5-29	South Facade	Recommended %24.5-29	East Facade	Recommended %20-25	West Facade	Recommended %20-25	Orientation	Degree	Control	MEB Recommended %25
COLD	**Csa** Van	7,2	X	10,4	X	18,4	X	14,9	X	East West	**17,9**	X	X
	Cfa Tosya/Kastamonu	3,4	X	3,4	X	14,3	X	11,8	X	East West	**14,2**	X	X
	Cfb Kastamonu	4,9	X	6,1	X	15,8	X	14,9	X	East West	**20**	✓	X
	Csb Sivas	1,8	X	1,8	X	14,5	X	18,2	X	East West	**19,2**	X	X
	BSk Konya	5,3	X	3,6	X	12,3	X	13,8	X	East West	**20,2**	✓	X
	BSh Ceylanpınar/Şanlıurfa	14,7	X	16,4	X	3	X	9,8	X	North South	**16,7**	X	X
	Dfb Ardahan	11,6	X	0,04	X	13,1	X	12,2	X	East West North	**E: 11,1 W: 11,1 N: 34,2**	X	X
	Dsa Muş	18,4	X	8,7	X	15,1	X	13,4	X	East West	**14,4**	X	X
	Dsb Ağrı	14,1	X	18,2	X	2,4	X	2,9	X	North South	**17,9**	X	X
		North Facade	Recommended %24.5-29	South Facade	Recommended %24.5-29	East Facade	Recommended %20-25	West Facade	Recommended %20-25	Sample Classrooms			MEB Recommended %25
WARM	**Csa** Şanlıurfa	13,8	✓	9,7	X	17	✓	15,9	✓	East West	**16,7**	✓	X
	Cfa Afyonkarahisar	15,8	✓	18	X	21,5	X	15,8	✓	North South	**18,2**	X	X
	Cfb Kastamonu	4,9	X	6,1	X	15,8	X	14,9	X	East West	**20**	✓	X
	Csb Gümüşhane	10,9	X	11,7	X	0	X	10	X	North South	**13,6**	✓	X
	BSk Malatya	21,5	X	33,4	X	9,8	X	2,2	X	North South	**16**	✓	X
	BSh Ceylanpınar/Şanlıurfa	14,7	X	16,4	X	3	X	9,8	X	North South	**16,7**	X	X
	Dfb Erzurum	13,5	✓	15,1	✓	3,6	X	3,6	X	North South	**N: 18,3 S: 20,2**	X	X
	Dsa Muş	18,4	X	8,7	X	15,1	X	13,4	X	East West	**14,4**	X	X
	Dsb Ağrı	14,1	X	18,2	X	2,4	X	2,9	X	North South	**17,9**	X	X

Table 13. Investigation of window-floor area ratio (WFR) parameters of high school

HIGH SCHOOL TYPE PROJECTS		Window-Floor Area Ratio (%)								Sample Classrooms			
Köppen Climate Classification	Köppen Climate Classification Codes	North Facade	Recommended %24.5-29	South Facade	Recommended %24.5-29	East Facade	Recommended %20-25	West Facade	Recommended %20-25	Orientation	Degree	Control	MEB Recommended %25
COLD	**Csa** Van	15,8	X	14,3	X	2,8	X	2,8	X	North Güney	**N: 18,9 S: 18,1**	X	X
	Cfb Kastamonu	18,8	X	22,1	X	10	X	4	X	North South	**16,6**	X	X
	Csb Sivas	19,8	X	23,6	X	10,6	X	10,7	X	North South	**21,1**	X	X
	BSk Konya	2,8	X	4,7	X	12,6	X	14,7	X	East West	**E: 18 W: 13,5**	X	X
	BSh Ceylanpınar/Şanlıurfa	15,9	X	16	X	14	X	14,2	X	North South	**17,9**	X	X
	Dsa Muş	11,8	X	10,7	X	7,2	X	9,9	X	North South	**11,4**	X	X
	Dsb Ağrı	9	X	10,4	X	2,5	X	13,1	X	North South	**11,2**	X	X
		North Facade	Recommended %24.5-29	South Facade	Recommended %24.5-29	East Facade	Recommended %20-25	West Facade	Recommended %20-25	Sample Classrooms			MEB Recommended %25
WARM	**Csa** Şanlıurfa	15,7	✓	13,4	X	3,9	X	3,9	X	North South	**15,3**	✓	X
	Cfa Afyonkarahisar	19,4	X	16,1	✓	3,9	X	3,1	X	North South	**16**	✓	X
	Cfb Kastamonu	18,8	X	22,1	X	10	X	4	X	North South	**16,6**	X	X
	BSk Malatya	9,4	X	12,4	X	11	X	11	X	North South	**14,5**	✓	X
	BSh Ceylanpınar/Şanlıurfa	15,9	X	16	X	14	X	14,2	X	North South	**17,9**	X	X
	Dfb Erzurum	2,6	X	2,9	X	15,2	✓	12,4	X	East West	**E: 13,3 X W: 18 ✓**	X ✓	X
	Dsa Muş	11,8	X	10,7	X	7,2	X	9,9	X	North South	**11,4**	X	X
	Dsb Ağrı	9	X	10,4	X	2,5	X	13,1	X	North South	**11,2**	X	X

Notably, at least one facade of primary schools meets the recommended window-to-floor area ratio (WFR) of 38%, while this ratio is only 16% in secondary and high schools. Schools' responsiveness to climate is compromised by inappropriate orientation choices disregarding climatic conditions. For instance, the orientation of classrooms to the west—55.5% in primary schools and 50% in secondary schools—results in excessive heat gain during the afternoon, diminishing overall comfort. Furthermore, it is important to highlight that the optimal WFR value of 25%, as recommended by the Ministry of National Education for educational buildings, was not achieved in any of the schools examined. This discrepancy underscores a critical area for improvement and emphasises the necessity of aligning architectural design with established standards to enhance the learning environment. The findings suggest that the typological design of educational structures across various climates fails to adequately address specific climatic needs, indicating a significant opportunity for improvement in future school designs.

5. Discussion

5.1. Hypothesis 1: Public schools are typical in Türkiye

Buildings for primary, secondary and high school education in Türkiye mostly employ standardized architectural platforms which seek to reduce project costs and construction time and minimize errors through linear layouts and repetitive facade details. The standardized architectural approach for school buildings tends to disregard location-specific factors which makes the educational delivery less effective for different cultural needs of students throughout the country. Some research has shown that many schools in Türkiye are built from reinforced concrete building materials and that the architectural appearance of the majority of schools does not reflect regional characteristics [65]. Moreover, such standardised designs that are common in designing learning environments fail to create learning environments that appropriately enhance the educational processes of diverse students by incorporating relevant characteristics such as local climates, cultural identity, or values of communities [66].

Working with standard school building types causes both students' affiliation to their educational setting as well as flexible learning environment development to be overlooked in traditional school architecture [67].

5.2. Hypothesis 2: Schools are not constructed in alignment with local climate

The study has discovered that Turkish educational buildings contain insufficient architectural structures which produces spaces with poor quality and creates problems with shading and ventilation systems along with heating and insulation needs. The combination of high WWR ratios in southern Türkiye creates buildings that absorb too much heat while exposing themselves to direct sunlight and lacking proper insulation which results in detrimental effects on student health. The implementation of buildings that do not respond to local climates leads to significant unpleasantness for students in educational spaces resulting in lower student performance through increased health-related absences in hot areas and respiratory issues from cold drafts and humidity in colder climates. [68]. Studies have demonstrated that students exposed to uncomfortable learning environments negatively affect student concentration, reduce academic performance, and increase anxiety [69]. Unsuitable school designs based on climate lead to unpleasant indoor environments which reduces learning quality as heat from the sun impedes learning though it improves academic results up to 7% to 18% and cold temperatures make students tired. [70]. These results confirm the importance of seriously considering climate-responsive approaches and concepts in the planning of educational institutions in order to improve students' comfort and, therefore, their health and success.

5.3. Equity and educational inequality

The complex link between educational building standardization and climate-unresponsive school designs forms the basis of two main hypotheses (Hypothesis 1 and Hypothesis 2). The first hypothesis indicates that standardized school building designs might create uniformity which ignores building context along with failing to support students with different learning requirements. Various climatic zones demonstrate non-compliance with window-to-wall and window-to-floor ratios standards that exist for educational building design. The second hypothesis demonstrates how unresponsive educational building designs create adverse outcomes when applied to climate-responsive features such as shading elements and insulation material. Climate-unresponsive design produces learning spaces which discomfort students physically thus reducing their ability to concentrate [71].

Accurate research reveals primary educational facilities with appropriate shading elements decrease their cooling requirements by 40% within hot dry conditions [72]. Homes that lack proper heating and insulation systems in cold regions become uncomfortably cold which creates adverse study conditions for students [73]. Children facing environmental stressors experience negative effects on their education particularly when they come from low socioeconomic areas [74]. The way classrooms handle climate changes can result in unfair distribution of benefits which affects educational equity between different zones. Students learn less effectively when their classrooms lack sufficient ventilation and air conditioning in regions with extreme climate conditions thus creating learning benefit disparities between students. Equity in education matters more because countries operate distinct school education systems. Heat adversely affects student mental processing capabilities along with academic performance and increases their stress levels [75]. Modern insulation systems are missing from older schools located in cold climate zones which negatively affects student learning conditions [76]. Academic differences emerge because of this situation and create persistent disadvantage patterns between students [77]. Educational settings need to establish climate adaptation plans together with equality-focused initiatives that give children equal education opportunities.

5.4. Policy and practice recommendations

The current educational structures of Türkiye must adopt diverse building solutions to serve the target population. An extensive solution requires alignment between policy development and design approaches together with public relations strategies. The Ministry of National Education must adapt their policies through financial backing and community engagement for implementation success. Natural cooling elements should be integrated into sustainable building designs. A classroom design that incorporates operable windows acts to improve ventilation and comfort levels along with reducing building energy consumption rate [78]. Quality insulation materials work to block both heat loss as well as heat intake when temperatures become extreme. Orientation plans for buildings must facilitate the maximum entry of natural light along with the reduction of solar rays hitting buildings directly [79]. The installation of large windows coming from north or south directions produces beneficial effects for both lighting conditions and energy conservation. These windows improve comfort levels and efficiency performance of the building [80]. The improvement of education in Türkiye requires future projects to integrate climate responsibility into their extensive design specifications.

The specifications should integrate environmental elements together with materials and energy-efficient technological components. School building evaluation regarding performance together with energy consumption data can guide current and future design principles and policy development. Educational facilities that address student needs result from partnership work between policymakers with educators and architects.

5.5. Limitations and challenges

The research examined educational buildings across pilot areas in Türkiye through temperature assessment within ten different climatic zones. The research did not include private educational institutions because they differed in their construction designs and operational methods and some climate-responsive design data were unavailable from architectural plans.

5.6. Suggestions for future research

The research team in Türkiye studies educational architecture through historical political and economic factors that caused school variety to decrease. The researchers want to understand the effects that development policies along with funding mechanisms and architectural trends have on education. The analysis of climate-adaptive school designs across countries provides governmental institutions and architects with a sustainable approach to develop educational buildings that respect cultural patterns as well as social requirements and climatic conditions.

6. Conclusions

This study focuses on the importance of educational building design in students' learning spaces, particularly in Türkiye, a region where the effects of climate variations on educational building projects are neglected. The research, which supports the argument of the necessity of climate-responsive design approaches, analysed Türkiye's climate zones according to the Köppen climate classification and evaluated educational buildings in the pilot cities of each climate zone. The study showed that educational buildings have many similarities and that common architectural design may be inadequate in some respects because the local climate is not considered. A critical evaluation of some key design parameters, such as orientation and spatial layout, revealed major limitations in climate responsivity that may hinder student learning and equity across regions.

The climate-responsive design analysis of school environments pointed out that today's school designs increase our awareness of the discourse of inequality in educational environments and the demand for climate-responsive architecture. The research highlights the importance of considering climate-responsive approaches to designing educational buildings with effective indoor conditions for learning environments designed in the context of concepts of equity and sustainability. In addition, this research forms a basis for other studies that aim to further expand the framework of more inclusive and equitable learning environments in Türkiye. Experimental research is suggested to examine the short- and long-term effects of climate-responsive design on students' health, well-being, and achievement.

Acknowledgments

This study is produced from the master's thesis titled "The Effect of Building Design on Indoor Thermal Comfort in Educational Buildings in Different Climatic Regions of Türkiye," conducted within the Department of Architecture at Dokuz Eylül University, Institute of Science, under the supervision of Assistant Professor Dr. Gizem İzmir Tunahan. I would like to express my sincere gratitude to Dr. İzmir Tunahan for her invaluable guidance and support throughout the thesis process. I also extend my thanks to the Ministry of National Education for providing essential data and supporting the research.

References

[1] E. Firman and K. S. Dedy Sandiarsa, "The Effect of Learning Environment on Students' Motivation in Learning," *Jurnal Ilmiah Mandala Education (JIME)*, vol. 10, no. 4, pp. 1046–1051, 2024, doi: 10.58258/jime.v9i1.7614/http.

[2] J. E. Baluyos, A. C. Canastra, J. Dionio, H. Ilusorio, C. C. Jimenez, and G. R. Baluyos, "Influence of Environmental Conditions and The Students' Health," *ARRUS Journal of Social Sciences and Humanities*, vol. 4, no. 2, pp. 255–269, 2024, doi: 10.35877/soshum2507.

[3] I. B. Chrzanowska, "Educational Space in Inclusive Education – Challenges in Working witha Diverse Group/Class," *Lubelski Rocznik Pedagogiczny*, vol. 42, no. 4, pp. 59–75, 2024, doi: 10.17951/lrp.2023.42.4.59-75.

[4] O. Ndimako, O. Babalola, and U. Ugah, "Students' Wellness and Mindfulness in School Designs," 2024. doi: 10.20944/preprints202408.1518.v1.

[5] G. Akkose, C. Meral Akgul, and I. G. Dino, "Educational building retrofit under climate change and urban heat island effect," *Journal of Building Engineering*, vol. 40, Aug. 2021, doi: 10.1016/j.jobe.2021.102294.

[6] C. Lops, F. Serpilli, V. D'Alessandro, and S. Montelpare, "Climate Change and Building Renovation: The Impact of Historical, Current, and Future Climatic Files on a School in Central Italy," *Applied Sciences (Switzerland)*, vol. 14, no. 19, Oct. 2024, doi: 10.3390/app14199067.

[7] C. Baglivo, "Dynamic evaluation of the effects of climate change on the energy renovation of a school in a mediterranean climate," *Sustainability (Switzerland)*, vol. 13, no. 11, Jun. 2021, doi: 10.3390/su13116375.

[8] Y. Yaşar, A. Pehlevan, and E. Altıntaş, "İlköğretim dersliklerinde termal konfor araştırması," in *VIII. Ulusal Tesisat Mühendisliği Kongresi*, 2007, pp. 199–208.

[9] Y. Afacan, "Impact of Climate Zone and Orientation Angle on the Recurring Massing School Typologies in Turkey," in *Sustainability in Energy and Buildings 2021*, vol. 263, J. R. Littlewood, R. J. Howlett, and L. C. Jain, Eds., Springer, 2022, pp. 11–27. [Online]. Available: http://www.springer.com/series/8767

[10] J. M. Evans and S. Schiller, "Bridging the gap between climate and design: A bioclimatic design course for architectural students in Argentina," *Energy Build*, vol. 15, no. 1–2, pp. 43–50, 1990.

[11] E. Ş. Özen and Ö. Sümengen, "Türkiye'nin Farklı İklim Bölgelerinde 'Binalarda Gün ışığı Kullanımı' Standartı Çerçevesinde Değerlendirilmesi," *Fen Bilimleri Enstitüsü Dergisi*, vol. 38, no. 2, pp. 292–313, 2022.

[12] P. Gaonkar, A. Nakkeeran, J. Bapat, and D. Das, "Air quality and thermal comfort management for energy-efficient large public buildings," *Architecture, Structures and Construction*, vol. 3, no. 1, pp. 25–40, Apr. 2023, doi: 10.1007/s44150-022-00059-4.

[13] A. Chazarra Bernabé, B. Lorenzo Mariño, R. Romero Fresneda, and J. V. M. G. Moreno García, "Observed Changes of Köppen Climate Zones in Spain since 1951," *Espacio Tiempo y Forma. Serie VI, Geografía*, no. 16, pp. 133–144, 2023, doi: 10.5944/etfvi.16.2023.38777.

[14] Kuranlıoğlu, D. and İzmir Tunahan, G. "Türkiye'nin İklimsel Çeşitliliği Bağlamında Mimari Tasarımda Tek Tip Proje Yaklaşımının Değerlendirilmesi," in *1. Bilsel International Midas Scientific Researches Congress*, G. Yaldız, Ed., Eskişehir, Türkiye: Bilsel Publishing, Mar. 2025, pp. 206–219.

[15] T. Glaves and M. Talpade, "An Exploration of The Types of Educational Environments Deemed Optimal for Learning by Students," *International Journal of Arts, Humanities & Social Science*, vol. 5, no. 6, pp. 31–37, 2024, doi: 10.56734/ijahss.v5n6a5.

[16] P. Cardellino and P. Woolner, "Designing for transformation – a case study of open learning spaces and educational change," *Pedagogy Culture and Society*, vol. 28, no. 1, pp. 1–20, 2019.

[17] L. Wang, "Relationships between Acoustics, Thermal, Indoor Air Quality, and Lighting Conditions on Student Achievement in K-12 Classrooms," in *INTER-NOISE and NOISE-CON Congress and Conference Proceedings*, Glasgow, Scotland: Institute of Noise Control Engineering, Feb. 2023, pp. 260–263.

[18] T. Cătălina and T. Banu, "Impact of indoor environmental conditions on students intellectual performance," *Buletinul Institutului Politehnic Din Iași*, vol. 64, no. 3, pp. 23–35, 2014.

[19] R. E. C. Lucas, L. B. da Silva, E. L. de Souza, W. K. dos S. Leite, and J. M. N. da Silva, “Influence of environmental variables on students’ cognitive performance in indoor higher education environments,” *Work*, vol. 79, pp. 351–360, 2024, doi: 10.3233/wor-220055.

[20] G. I. Earthman, “School Facility Conditions and Student Academic Achievement,” 2002. Accessed: Jan. 10, 2025. [Online]. Available: https://escholarship.org/uc/item/5sw56439

[21] S. Gölemen, N. Taş, and M. Taş, “The changes of sustainable primary school buildings,” in *Eco-Architecture VI: Harmonisation between Architecture and Nature*, WIT Press, Jul. 2016, pp. 11–22. doi: 10.2495/arc160021.

[22] J. Gu and F. Bal Koçyiğit, “Zero Consumption Monotype Education Buildings,” 2018. [Online]. Available: http://dergipark.gov.tr/gujs

[23] F. N. Aksin and S. A. Selçuk, “Energy performance optimization of school buildings in different climates of Turkey,” *Future Cities and Environment*, vol. 7, no. 1, 2021, doi: 10.5334/fce.107.

[24] H. D. Arslan, “Evaluation of a School Building in Turkey According to the Basic Sustainable Design Criteria,” in *IOP Conference Series: Earth and Environmental Science*, Institute of Physics Publishing, Sep. 2017. doi: 10.1088/1755-1315/83/1/012026.

[25] T. Ashrafian, “Enhancing school buildings energy efficiency under climate change: A comprehensive analysis of energy, cost, and comfort factors,” *Journal of Building Engineering*, vol. 80, Dec. 2023, doi: 10.1016/j.jobe.2023.107969.

[26] R. Afren, M. Benabbas, N. Zemmouri, and D. Djaghrouri, “Impact of the typology of school buildings on the internal thermal conditions, in a hot and dry climate,” in *Energy Procedia*, Elsevier Ltd, 2017, pp. 505–510. doi: 10.1016/j.egypro.2017.07.305.

[27] A. Kaihoul, E. Pitzali, and L. Sriti, “An Exploration of Climate-Responsive Design Strategies Employed by El-Miniawy Brothers in Southern Algeria,” *Journal of Sustainable Architecture and Civil Engineering*, vol. 35, no. 3, pp. 32–54, 2024, doi: 10.5755/j01.sace.35.3.36863.

[28] D. Maučec, M. Premrov, and V. Ž. Leskovar, “Use of sensitivity analysis for a determination of dominant design parameters affecting energy efficiency of timber buildings in different climates,” *Energy for Sustainable Development*, vol. 63, pp. 86–102, Aug. 2021, doi: 10.1016/j.esd.2021.06.003.

[29] H. Benharchache, F. Khaldi, and M. Hanfer, “The Effect of External Walls on Energy Performance of Algerian Rural Building in Different Climatic Zones,” *Journal of Advanced Research in Fluid Mechanics and Thermal Sciences*, vol. 107, no. 2, pp. 171–190, Jul. 2023, doi: 10.37934/arfmts.107.2.171190.

[30] N. Amani, “Simulation-based design: minimizing energy consumption in residential buildings through optimal thermal insulation,” *World Journal of Engineering*, 2024, doi: 10.1108/WJE-04-2024-0188.

[31] H. Tawfeeq and A. M. A. Qaradaghi, “Optimising Window-to-Wall Ratio for Enhanced Energy Efficiency and Building Intelligence in Hot Summer Mediterranean Climates,” *Sustainability*, vol. 16, no. 17, p. 7342, Aug. 2024, doi: 10.3390/su16177342.

[32] A. Kabanshi, G. Choonya, A. Ameen, W. Liu, and E. Mulenga, “Windows of Opportunities: Orientation, Sizing and PV-Shading of the Glazed Area to Reduce Cooling Energy Demand in Sub-Sahara Africa,” *Energies (Basel)*, vol. 16, no. 9, May 2023, doi: 10.3390/en16093834.

[33] S. Mirrahimi, N. Lukman, N. Ibrahim, and M. Surat, “Estimation Daylight to Find Simple Formulate Based on the Ratio of Window Area to Floor Area Rule of Thumb for Classroom in Malaysia,” *Research Journal of Applied Sciences, Engineering and Technology*, vol. 6, no. 5, pp. 931–935, 2013.

[34] Y. V. Perez and I. G. Capeluto, "Climatic considerations in school building design in the hot-humid climate for reducing energy consumption," *Appl Energy*, vol. 86, no. 3, pp. 340–348, 2009, doi: 10.1016/j.apenergy.2008.05.007.

[35] P. Kr. Chaturvedi, N. Kumar, R. Lamba, and K. Mehta, "Multi-objective optimization of glazing and shading configurations for visual, thermal, and energy performance of cooling dominant climatic regions of India," Sep. 27, 2024. doi: 10.21203/rs.3.rs-4983831/v1.

[36] K. Wehrli *et al.*, "Building design in a changing climate – Future Swiss reference years for building simulations," *Clim Serv*, vol. 34, Apr. 2024, doi: 10.1016/j.cliser.2024.100448.

[37] D. Satpal, A. Kalpana, and B. Kumar, "Optimizing Energy Efficiency to Design IGBC Green Schools in Composite Climate," in *IOP Conference Series: Earth and Environmental Science*, Institute of Physics, 2024. doi: 10.1088/1755-1315/1326/1/012045.

[38] M. Salameh and B. Touqan, "Designing Climate-Adaptive Buildings: Impact of Courtyard Geometry on Microclimates in Hot, Dry Environments," *Civil Engineering Journal (Iran)*, vol. 10, no. 8, pp. 2698–2718, Aug. 2024, doi: 10.28991/CEJ-2024-010-08-017.

[39] S. C. Asha and M. A. Blessing, "Environment Modifying in Inclusive Education," *Shanlax International Journal of Arts, Science and Humanities*, vol. 11, no. Special Issue 1, pp. 5–9, 2023, doi: 10.34293/sijash.

[40] T. Vinsela Jeev, "Causes and Effects of Climate Change in Education," *Shanlax International Journal of Arts, Science and Humanities*, vol. 11, no. Special Issue 2, pp. 65–68, 2024, doi: 10.34293/sijash.

[41] S. Venegas Marin, L. Schwarz, and S. Sabarwal, "Impacts of Extreme Weather Events on Education Outcomes: A Review of Evidence," *World Bank Res Obs*, vol. 39, no. 2, pp. 177–226, 2024.

[42] M. H. AL Hussaini, "Impact of Climate on Student Education and Their Future Development," *International Journal of Integrative Sciences*, vol. 2, no. 4, pp. 525–534, May 2023, doi: 10.55927/ijis.v2i4.3951.

[43] E. M. Preña and C. P. Labayo, "Policy responses to extreme heat and its impact on education: The Philippine experience," *Policy Futures in Education*, 2024, doi: 10.1177/14782103241288276.

[44] Y. K. Juan and Y. Chen, "The influence of indoor environmental factors on learning: An experiment combining physiological and psychological measurements," *Build Environ*, vol. 221, Aug. 2022, doi: 10.1016/j.buildenv.2022.109299.

[45] H. W. Brink, M. G. L. C. Loomans, M. P. Mobach, and H. S. M. Kort, "Classrooms' indoor environmental conditions affecting the academic achievement of students and teachers in higher education: A systematic literature review," *Indoor Air*, vol. 31, no. 2, pp. 405–425, Mar. 2021, doi: 10.1111/ina.12745.

[46] A. Michael and C. Heracleous, "Assessment of natural lighting performance and visual comfort of educational architecture in Southern Europe: The case of typical educational school premises in Cyprus," *Energy Build*, vol. 140, pp. 443–457, Apr. 2017, doi: 10.1016/j.enbuild.2016.12.087.

[47] Z. S. Zomorodian, M. Tahsildoost, and M. Hafezi, "Thermal comfort in educational buildings: A review article," Jun. 01, 2016, *Elsevier Ltd*. doi: 10.1016/j.rser.2016.01.033.

[48] Y. P. Villarreal Arroyo, R. Peñabaena-Niebles, and C. Berdugo Correa, "Influence of environmental conditions on students' learning processes: A systematic review," Mar. 01, 2023, *Elsevier Ltd*. doi: 10.1016/j.buildenv.2023.110051.

[49] P. Sarıcıoğlu and İ. Ayçam, "A framework for the evaluation of buildings in the context of climate change for Turkey," *GRID - Architecture, Planning and Design Journal*, Jul. 2021, doi: 10.37246/grid.934644.

[50] Y. Yildiz and M. Kocyigit, "Energy consumption analysis of education buildings: The case study of balikesir university," *Gazi University Journal of Science*, vol. 34, no. 3, pp. 665–677, 2021, doi: 10.35378/gujs.722746.

[51] E. Bölük, O. Eskioğlu, Y. Çalık, and S. Yağan, "Köppen İklim Sınıflandırmasına Göre Türkiye İklimi," Jan. 2023.

[52] Meteoroloji Genel Müdürlüğü, "İllere Ait Mevsim Normalleri (1991-2020)," https://www.mgm.gov.tr/veridegerlendirme/il-ve-ilceler-istatistik.aspx?k=H. Accessed: Nov. 16, 2025. [Online]. Available: https://www.mgm.gov.tr/veridegerlendirme/il-ve-ilceler-istatistik.aspx?k=H

[53] Weather Spark, "The Weather Year Round Anywhere on Earth," https://weatherspark.com/. Accessed: Nov. 14, 2024. [Online]. Available: https://weatherspark.com/

[54] Z. Qin, "Credibilistic Mean-Absolute Deviation Model," in *Uncertainty and Operations Research Uncertain Portfolio Optimization*, Beijing, China: Springer, 2016, ch. 3, pp. 53–67. [Online]. Available: http://www.springer.com/series/11709

[55] Milli Eğitim Bakanlığı, "Eğitim Yapıları Asgari Tasarım Standartları Kılavuzu," 2015.

[56] U. Atmaca, "TS 825 Binalarda Isı Yalıtım Kuralları Standardındaki Güncellemeler," *Tesisat Mühendisliği*, no. 154, pp. 21–35, 2016.

[57] Vstarenergy, "Building Thermal Rating Assessors," Vstarenergy. Accessed: Dec. 20, 2024. [Online]. Available: https://vstarenergy.com.au/2024/08/19/window-to-wall-ratio/#:~:text=Ideal%20WWR%3A%2020%2D40%25,enhance%20energy%20efficiency%20and%20comfort

[58] E. Bölük, O. Eskioğlu, Y. Çalık, and S. Yağan, "Köppen İklim Sınıflandırmasına Göre Türkiye İklimi," Jan. 2023.

[59] A. Caporale, F. Gabriele Galizia, L. Botti, and C. Mora, "Thermal comfort prediction of aged industrial workers based on occupants' basal metabolic rate," in *Social and Occupational Ergonomics*, AHFE International, 2022. doi: 10.54941/ahfe1002666.

[60] U. Unver, E. Adigüzel, E. Adıgüzel, and S. Çivi, "Türkiye'deki İklim Bölgelerine Göre Binalarda Isı Yalıtım Uygulamaları Application of Thermal Insulation in Buildings by Climate Zones in Turkey," *İleri Mühendislik Çalışmaları ve Teknolojileri Dergisi*, vol. 1, no. 2, pp. 171–187, 2020, [Online]. Available: https://www.researchgate.net/publication/348371986

[61] T. K. P. Nguyen and E. V. Korkina, "Connectivity of the Window to Floor Area Ratio and the Daylighting Assessment Criteria," *Iranian Journal of Science and Technology - Transactions of Civil Engineering*, vol. 45, no. 3, pp. 2035–2045, Sep. 2021, doi: 10.1007/s40996-021-00681-0.

[62] M. M. Hassieb, A. Ragab, and A. F. Mohamed, "Quantifying the Influence of Window-to-Wall Ratio (WWR) on Indoor Air Quality and Thermal Comfort: Classroom Study in Hot Arid Climates," in *IOP Conference Series: Earth and Environmental Science*, Institute of Physics, 2024. doi: 10.1088/1755-1315/1396/1/012025.

[63] E. Garcia-Nevado, B. Beckers, H. C. Roura, and I. Crespo, "Façade design and energy demand: fenestration indexes from an urban approach," 2017.

[64] S. A. Olaniyan, I. I. Adebisi, and O. O. . Onigbogi, "Between Fancy and Functionality: Comparative Thermal Performance Analyses of Selected External Building Shading Elements in Tropical Building Design," *LAUTECH Journal of Civil and Environmental Studies*, vol. 11, no. 1, Sep. 2023, doi: 10.36108/laujoces/3202.11.0140.

[65] F. Işıker and M. F. Bölük, "Okul tasarımlarında mekansal olasılıklar," in Uluslararası Mimarlık ve Tasarım Kongresi, İstanbul Bilim ve Akademisyenler Derneği, 2016, pp. 142–152.

[66] K. Çelik, "Eğitim yapıları tasarım kılavuzları bağlamında dersliklerin görsel konfor ve enerji kullanımı değerlendirilmesi," Journal of International Social Research, vol. 12, no. 63, pp. 441–447, Apr. 2019, doi: 10.17719/jisr.2019.3241.

[67] C. Demir Yıldız and B. Dönmez, "Anadolu Liseleri Tip Projelerinin Milli Eğitim Bakanlığı Eğitim Yapıları Asgari Tasarım Standartları Açısından Değerlendirilmesi," in Eğitim Yönetimi Araştırmaları, 1st ed., S. Altun, D. Örücü, K. Beycioğlu, Y. Kondakçı, and S. Koşar, Eds., Pegem Akademi, 2017, pp. 204–221. doi: 10.14527/9786052411551.

[68] G. Özer, P. Çulun, and F. Kürüm Varolgüneş, "Assessment and improvement of thermal comfort conditions in educational buildings: an example of a secondary school," *Türk Doğa ve Fen Dergisi*, vol. 13, no. 4, pp. 91–106, Dec. 2024, doi: 10.46810/tdfd.1525408.

[69] S. Sadrizadeh *et al.*, "Indoor air quality and health in schools: A critical review for developing the roadmap for the future school environment," *Journal of Building Engineering*, vol. 57, Oct. 2022, doi: 10.1016/j.jobe.2022.104908.

[70] A. Baba, I. Shahrour, and M. Baba, "Indoor Environmental Quality for Comfort Learning Environments: Case Study of Palestinian School Buildings," *Buildings*, vol. 14, no. 5, May 2024, doi: 10.3390/buildings14051296.

[71] S. Okçu, E. Ryherd, and C. Bayer, "The role of physical environment on student health and education in green schools," *Rev Environ Health*, vol. 26, no. 3, pp. 169–179, 2011.

[72] S. Aghamohammadiha and N. Dehghan, "Optimum Geometry of Double-skin Self-Shading Facade of Classrooms with the Aim of Creating Energy Saving and Visual Comfort in Isfahan Province, Iran," *Journal of Daylighting*, vol. 11, no. 2, pp. 372–389, Nov. 2024, doi: 10.15627/jd.2024.25.

[73] P. Singh, "Indoor Environmental Quality & Student Health and Performance: A Conceptual Review," 2013. [Online]. Available: http://www.ijmra.us

[74] S. Mathiarasan and A. Hüls, "Impact of environmental injustice on children's health—interaction between air pollution and socioeconomic status," Jan. 02, 2021, *MDPI AG*. doi: 10.3390/ijerph18020795.

[75] B. Lala and A. Hagishima, "Impact of Escalating Heat Waves on Students' Well-Being and Overall Health: A Survey of Primary School Teachers," *Climate*, vol. 11, no. 6, Jun. 2023, doi: 10.3390/cli11060126.

[76] P. Alamdari, "Primary School Buildings Renovation in Cold Climates: Optimizing Window Size and Opening for Thermal Comfort, Indoor Air Quality, and Energy Performance," 2022. [Online]. Available: https://www.researchgate.net/publication/365747113

[77] A. Altassan, "Sustainable Integration of Solar Energy, Behavior Change, and Recycling Practices in Educational Institutions: A Holistic Framework for Environmental Conservation and Quality Education," *Sustainability (Switzerland)*, vol. 15, no. 20, Oct. 2023, doi: 10.3390/su152015157.

[78] J. Kim, H. Naganathan, S. Moon, and D. Jang, "Optimizing Comfort and Sustainability: The Impact of Passive Cooling and Eco-Friendly Materials on Indoor Temperature Reduction—A Case Study," *Buildings*, vol. 14, no. 10, Oct. 2024, doi: 10.3390/buildings14103218.

[79] G. Lamberti, G. Salvadori, F. Leccese, F. Fantozzi, and P. M. Bluyssen, "Advancement on thermal comfort in educational buildings: Current issues and way forward," *Sustainability (Switzerland)*, vol. 13, no. 18, Sep. 2021, doi: 10.3390/su131810315.

[80] S. Jaouaf, B. Bensaad, and M. Habib, "Passive strategies for energy-efficient educational facilities: Insights from a mediterranean primary school," *Energy Reports*, vol. 11, pp. 3653–3683, Jun. 2024, doi: 10.1016/j.egyr.2024.03.040.

Appendices

Appendix 1

Table 1. Annual temperature data of cities belonging to the Csa climate type

CSA / Cities	January	February	March	April	May	June	July	August	September	October	November	December
Şanlıurfa Average Temperature	5,6	7,1	10,9	16,3	22,3	28,1	32	31,6	27,2	20,6	13,2	7,6
Average maximum temperature	10	12	16,4	22,4	28,8	34,7	38,8	38,4	34	27,1	18,8	12,1
Average minimum temperature	2,1	2,9	5,8	10,3	15,3	20,6	24,3	24	20,1	14,6	8,5	4,1
Batman Average Temperature	2,5	4,6	9,2	14,4	19,4	26	30,2	29,6	24,3	17,4	9,7	4,4
Average maximum temperature	7,8	10,7	15,9	21,7	27,8	35,1	39,5	39,5	34,6	26,7	17	9,7
Average minimum temperature	-1,5	0	3,7	7,9	11,4	15,9	20,3	19,7	15	10,1	4,2	0,5
Diyarbakır Average Temperature	1,8	3,7	8,3	13,8	19,3	26,1	31	30,5	25,1	17,6	9,8	4,1
Average maximum temperature	6,8	9,2	14,5	20,5	26,6	33,6	38,4	38,3	33,4	25,4	16,4	9,2
Average minimum temperature	-2,2	-1	2,5	7	11,3	16,6	21,7	21,1	16	10,1	4,2	-0,1
Aydın Average Temperature	8,2	9,4	11,8	16	20,9	25,6	28,3	27,7	23,8	18,7	13,6	9,6
Average maximum temperature	13,1	14,8	17,9	22,8	28,3	33,4	36,3	35,9	32,1	26,3	19,9	14,6
Average minimum temperature	4,3	5,1	6,7	10,1	14,3	18,2	20,6	20,4	16,9	12,8	8,9	5,8
Adıyaman Average Temperature	4,6	6	10	15,1	20,6	26,7	31,1	30,7	26	19,3	11,8	6,7
Average maximum temperature	8,7	10,5	15	20,7	26,8	33,3	37,9	37,8	33,2	25,7	17,1	10,8
Average minimum temperature	1,4	2,5	5,6	10	14,4	19,8	23,8	23,5	19,2	13,8	7,7	3,5
Kilis Average Temperature	5,8	7,1	10,7	15,5	20,7	25,3	28,2	28,1	25,2	20	13	7,7
Average maximum temperature	9,8	11,8	16,1	21,6	27,7	32,9	36,3	36,3	32,8	26,5	18,3	11,8
Average minimum temperature	2,4	3,3	6,1	10,1	14,4	18,4	21,3	21,4	18,7	14,4	8,4	4,2
Siirt Average Temperature	2,7	4,3	8,4	13,9	19,5	26	30,7	30,4	25,6	18,3	10,6	4,9
Average maximum temperature	6,7	8,9	13,4	19,3	25,3	32,3	37,1	37,1	32,3	24,5	15,5	8,9
Average minimum temperature	-0,5	0,6	4,1	9	13,7	19,1	23,5	23,3	18,9	12,8	6,5	1,7
Manisa Average Temperature	6,6	7,9	10,5	15,1	20,3	25,2	28	27,7	23,4	17,8	12,2	8,1
Average maximum temperature	10,8	12,7	16,2	21,5	27,1	32,1	35	34,9	30,8	24,4	17,6	12,3
Average minimum temperature	3	3,7	5,3	8,9	13,4	17,6	20,5	20,4	16,2	11,8	7,6	4,5
Kahramanmaraş Average Temp.	4,8	6,2	10,4	15,1	20,1	24,9	28,3	28,5	25	18,9	11,9	6,7
Average maximum temperature	9,3	11,2	15,9	21,3	26,8	32	35,8	36,2	32,7	26,1	17,9	11,3
Average minimum temperature	1,4	2,5	5,8	9,9	14,1	18,7	22,2	22,3	18,5	13	7,2	3,4
Adana Average Temperature	9,5	10,6	13,5	17,6	21,9	25,6	28,3	28,7	26,2	21,8	16	11,3
Average maximum temperature	14,8	16,2	19,4	23,8	28,3	31,7	33,9	34,7	33,1	29,1	22,7	16,9
Average minimum temperature	5,3	6	8,3	11,9	15,8	19,8	23	23,5	20,2	15,8	10,8	7
Denizli Average Temperature	5,9	7,2	10,2	14,7	19,6	24,3	27,4	27	22,7	17,1	11,7	7,7
Average maximum temperature	10,6	12,4	16	21	26,5	31,3	34,7	34,6	30,2	24	17,5	12,3
Average minimum temperature	2,4	3,1	5,4	9,2	13,4	17,5	20,3	20	16	11,5	7,2	4,2
Osmaniye Average Temperature	8,8	10,2	13,1	17,2	21,4	25,2	28	28,6	25,8	21,2	14,7	10,3
Average maximum temperature	14,7	16,2	19,1	23,6	27,9	31,2	33,7	34,4	32,3	28,4	21,8	16,4
Average minimum temperature	3,6	4,6	7,3	10,9	15	19	22,5	23,2	19,5	14,5	8,5	5,2
Gaziantep Average Temperature	3,1	4,5	8,2	13,4	18,9	24,3	28,1	27,9	23,5	16,8	9,9	5,1
Average maximum temperature	7,5	9,5	13,9	19,7	25,6	31,2	35,3	35,3	31,2	24,3	16,3	9,8
Average minimum temperature	-0,6	0,2	3,1	7,3	12	17,2	21,2	21,1	16,3	10,2	4,6	1,2
İzmir Average Temperature	8,8	9,6	11,7	15,9	20,8	25,4	28	27,7	23,8	19	14,3	10,6
Average maximum temperature	12,4	13,7	16,3	20,9	26,1	30,7	33,3	33	29,2	24,1	18,7	14,1
Average minimum temperature	5,8	6,2	7,7	11,2	15,5	19,9	22,5	22,4	18,7	14,7	10,8	7,6
Antalya Average Temperature	10	10,7	12,9	16,4	20,6	25,3	28,6	28,4	25,3	20,6	15,5	11,7
Average maximum temperature	14,9	15,6	18	21,4	25,7	30,7	34,2	34,1	31,2	26,6	21,3	16,7
Average minimum temperature	6	6,4	8,1	11,3	15,3	19,7	22,8	22,8	19,5	15,3	10,9	7,7
Mardin Average Temperature	3,1	4,2	8	13,5	19,5	25,6	29,8	29,7	25,4	18,7	11,1	5,5
Average maximum temperature	5,9	7,4	11,6	17,4	24	30,6	35,1	34,8	30,2	22,9	14,6	8,2
Average minimum temperature	0,6	1,4	4,7	9,8	15,1	20,3	24,6	24,8	20,9	14,7	8,1	3
Tunceli Average Temperature	-1,9	-0,1	5,6	11,8	16,8	22,4	27,1	26,8	21,6	14,6	6,9	1,1
Average maximum temperature	3,1	5,2	11,4	18,3	24,1	30,1	35,1	35,5	30,7	22,9	13,7	5,8
Average minimum temperature	-5,4	-4	1,1	6,2	10,1	14,5	18,9	18,5	13,4	8,2	2,1	-2,2
Palu/Elazığ Average Temperature	-1	1	6	12	17	23	28	28	22	15	7	2
Average maximum temperature	3	5	11	17	23	30	35	35	30	21	12	6
Average minimum temperature	-4	-3	1	6	10	15	20	19	14	8	3	-2
Balıkesir Average Temperature	4,7	6,1	8,8	12,8	17,8	22,6	25,5	25,6	21,3	16	10,4	6,4
Average maximum temperature	9,2	11,3	15	19,8	25,3	29,9	32,5	32,6	28,8	22,8	16,8	10,9
Average minimum temperature	0,9	1,7	3,3	6,3	10,5	15,1	18	18,6	14,3	10	5,4	2,6
Muğla Average Temperature	5,3	6,1	8,5	12,7	17,7	22,8	26,4	26,3	21,9	16,2	10,8	7
Average maximum temperature	9,8	11	14,1	18,9	24,3	29,6	33,5	33,6	29,3	23,2	16,7	11,6
Average minimum temperature	1,6	1,9	3,5	7	11,4	16,1	19,7	19,6	15,3	10,3	5,9	3,2
Şırnak Average Temperature	2,5	3,7	7,4	12,5	18,3	24,7	29,1	28,9	24,6	17,5	9,9	4,9
Average maximum temperature	6	7,4	11,3	16,6	22,6	29,4	33,9	33,8	29,4	21,8	13,7	8,3
Average minimum temperature	-0,7	0,3	3,7	8,3	13,5	19,6	23,9	23,9	19,7	13,2	6,2	1,6
Bingöl Average Temperature	-2,2	-1,1	4,2	10,8	16,2	22	26,7	26,5	21,3	14,3	6,8	0,8
Average maximum temperature	2,4	3,9	9,6	16,8	22,9	29,4	34,6	34,8	29,8	21,7	12,7	5,3
Average minimum temperature	-5,8	-4,9	-0,1	5,8	10,2	14,8	19	18,7	13,7	8,3	2,3	-2,7
Hatay Average Temperature	8,1	9,8	13,1	17,2	21,3	24,8	27,2	27,9	25,8	20,8	14,4	9,6
Average maximum temperature	12,1	14,5	18,1	22,6	26,6	29,2	31,2	32	31	27,4	20,2	13,7
Average minimum temperature	4,7	5,8	8,5	12,2	16,3	20,8	23,9	24,6	21,1	15,2	9,6	6
Edirne Average Temperature	2,7	4,4	7,6	12,8	18	22,2	24,7	24,5	20,1	14,5	9,2	4,6
Average maximum temperature	6,7	9,4	13,4	19,3	24,8	29,2	32	32	27,4	20,8	14,2	8,6
Average minimum temperature	-0,5	0,5	2,9	7,1	11,7	15,5	17,4	17,3	13,5	9,3	5,3	1,4

Ağın/ Elazığ Average Temperature	0	1	7	13	17	23	27	27	21	14	7	2
Average maximum temperature	3	6	12	18	23	29	33	33	28	20	12	5
Average minimum temperature	-4	-2	2	7	11	15	19	19	14	8	3	-1
Maden/Elazığ Average Temperature	-1	0	5	11	16	22	27	26	21	14	6	1
Average maximum temperature	2	5	10	16	22	29	34	33	28	20	11	5
Average minimum temperature	-5	-4	0	5	9	14	18	18	13	8	2	-3
Amasya Average Temperature	2,6	4,5	8,3	13,4	17,6	21,3	23,8	23,9	20	14,7	8,6	4,6
Average maximum temperature	7	9,8	14,5	20,4	25,1	28,7	31,1	31,6	27,9	21,9	14,7	8,9
Average minimum temperature	-0,8	0,3	3,1	7,2	11,1	14,5	16,7	16,8	13	8,7	4	1,4
Bursa Average Temperature	5,4	6,2	8,4	12,9	17,7	22	24,5	24,4	20,3	15,6	11,1	7,4
Average maximum temperature	9,6	10,9	13,8	19	23,9	28,3	30,9	31,1	27,2	22	16,6	11,7
Average minimum temperature	1,7	2,2	3,6	7,2	11,4	15	17,3	17,3	13,8	10,2	6,4	3,6
Mersin Average Temperature	10,3	11,2	13,8	17,6	21,4	25,1	27,9	28,4	25,9	21,6	16,3	12
Average maximum temperature	14,7	15,6	18,2	21,7	25	28,2	30,8	31,6	30,1	26,8	21,6	16,6
Average minimum temperature	6,4	7	9,3	13	17	21	24,1	24,4	21,1	16,5	11,7	8
Karakoçan/Elazığ Average Temp.	-2	-1	5	11	16	22	26	26	21	14	6	0
Average maximum temperature	2	4	10	16	22	28	33	33	28	20	11	4
Average minimum temperature	-6	-4	0	5	9	14	18	18	13	7	2	-3
Kırklareli Average Temperature	2,9	4,1	6,9	12	17,1	21,4	23,8	23,6	19,4	14,1	9,3	5,1
Average maximum temperature	6,9	8,6	12,2	17,9	23,5	28	30,7	30,7	26,2	20	13,9	8,8
Average minimum temperature	0,1	1	3	7,1	11,6	15,6	17,8	17,8	14,1	9,8	5,9	2,3
Burdur Average Temperature	2,6	3,8	6,9	11,7	16,5	21	24,6	24,6	20,2	14,5	8,9	4,3
Average maximum temperature	6,8	8,8	12,6	17,8	23,1	28	32	32,3	27,9	21,5	14,5	8,5
Average minimum temperature	-0,9	-0,3	1,9	6,1	10,2	14	17	17	12,9	8,4	4,1	0,9
Dinar/Afyonkarahisar Average Temp.	2	3	6	11	16	21	24	24	19	13	7	3
Average maximum temperature	6	8	12	17	22	28	31	31	27	20	13	8
Average minimum temperature	-2	-1	1	5	9	13	16	16	12	7	2	-1
Çanakkale Average Temperature	6,3	6,7	8,4	12,6	17,6	22,3	25,1	25,1	21,1	16,3	12,2	8,5
Average maximum temperature	9,6	10,3	12,5	17,3	22,7	27,8	30,8	30,7	26,5	20,9	16	11,8
Average minimum temperature	3,2	3,4	4,8	8,3	12,7	16,7	19,4	19,7	16,1	12,2	8,6	5,4
Erzincan Average Temperature	-2,9	-1,2	4,1	10,7	15,5	19,9	23,8	24	19,2	12,5	5,7	-0,1
Average maximum temperature	1,7	3,7	9,5	16,8	22,3	27,1	31,5	32,1	27,5	20	11,7	4,5
Average minimum temperature	-6,9	-5,3	-0,7	4,8	8,8	12,2	15,6	15,5	10,9	5,9	0,8	-3,9
Doğanşehir/Malatya Average Temp.	-1	0	5	10	15	21	25	25	20	13	6	1
Average maximum temperature	2	4	9	15	21	27	31	31	26	18	10	4
Average minimum temperature	-4	-3	1	5	9	14	18	18	13	8	2	-2
Geyve/Sakarya Average Temp.	5	6	8	13	17	21	23	23	20	15	10	6
Average maximum temperature	9	10	14	19	24	27	30	30	27	21	16	11
Average minimum temperature	1	1	3	7	11	14	17	17	13	10	5	2
Sivrice/Elazığ Average Temperature	-3	-1	4	10	15	20	25	25	19	12	5	-1
Average maximum temperature	1	3	9	15	21	27	32	31	26	18	9	3
Average minimum temperature	-6	-5	-1	4	8	13	17	17	12	6	0	-4
Arapgir/Malatya Average Temp.	-2	-1	5	11	15	20	25	24	19	12	5	0
Average maximum temperature	2	4	10	16	22	27	32	32	27	19	10	4
Average minimum temperature	-6	-4	0	4	8	13	16	16	11	6	0	-3
Baskil/Elazığ Average Temperature	-3	-1	4	10	15	20	24	24	19	12	5	0
Average maximum temperature	1	3	9	16	21	27	31	31	26	18	9	3
Average minimum temperature	-6	-5	-1	4	8	13	16	16	11	6	0	-4
Divriği/Sivas Average Temperature	-2	-1	5	11	15	20	23	23	19	12	5	0
Average maximum temperature	2	4	10	16	21	27	31	31	26	19	10	4
Average minimum temperature	-6	-5	0	4	8	12	15	15	10	6	0	-4
İstanbul Average Temperature	6,7	6,9	8,4	12,8	17,6	22,2	24,6	24,7	21,2	16,7	12,6	8,9
Average maximum temperature	9,6	10,2	12,3	17,3	22,2	26,9	29,6	29,6	25,9	20,6	16	11,8
Average minimum temperature	4,2	4,2	5,4	9,2	13,6	18	20,4	20,7	17,6	13,7	9,8	6,4
Tokat Average Temperature	1,9	3,6	7,4	12,5	16,4	19,7	22,1	22,4	18,9	13,8	8	3,8
Average maximum temperature	6,3	8,5	13,2	19,2	23,6	26,9	29,1	29,9	26,7	20,8	13,8	8
Average minimum temperature	-1,6	-0,6	2,5	6,6	10,2	13,3	15,6	15,8	12,3	8,3	3,5	0,4
Kayseri Average Temperature	-1,6	0,3	4,8	10,6	15,1	19	22,3	22,1	17,5	11,9	5,6	0,8
Average maximum temperature	4,2	6,3	11,5	17,8	22,6	26,9	30,7	30,9	26,7	20,5	13,1	6,6
Average minimum temperature	-6,7	-5,1	-1,3	3,2	6,9	9,9	12,1	11,6	7,5	3,6	-0,8	-4,3
Ankara Average Temperature	0,3	1,7	5,7	11,3	16,1	20	23,4	23,5	19	13,2	7,3	2,6
Average maximum temperature	4,3	6,5	11,5	17,4	22,4	26,6	30,3	30,5	26,1	20	13,1	6,6
Average minimum temperature	-3,2	-2,2	0,7	5,4	9,7	13	15,9	16,1	11,9	7,2	2,6	-0,7
Isparta Average Temperature	1,8	3	6	10,8	15,5	19,9	23,5	23,4	18,9	13,4	7,9	3,7
Average maximum temperature	6,3	7,8	11,6	16,7	21,9	26,6	30,4	30,7	26,6	20,6	14	8,3
Average minimum temperature	-1,9	-1,2	1	4,8	8,7	12,4	15,4	15,3	11,1	6,8	2,8	-0,1
Uşak Average Temperature	2,3	3,3	6,1	10,9	15,6	19,9	23,4	23,5	19,2	13,7	8,4	4,3
Average maximum temperature	6,9	8,3	11,7	16,8	21,9	26,5	30,4	30,7	26,4	20,3	14,2	8,9
Average minimum temperature	-1,2	-0,6	1,3	5,2	9,2	12,7	15,5	15,7	12	8	3,9	0,8
Kırşehir Average Temperature	-0,2	1,4	5,3	10,8	15,5	19,7	23,1	23,1	18,6	12,8	6,6	2,2
Average maximum temperature	4,6	6,7	11,3	17,2	22,1	26,3	29,9	30,1	26,1	20,1	13,1	7
Average minimum temperature	-4,2	-3,1	-0,2	4,4	8,6	12,4	15,7	15,7	11,1	6,1	1,2	-1,8

Gediz/Kütahya Average Temp.	3	3	7	11	16	20	24	24	20	14	8	4
Average maximum temperature	7	8	12	16	22	26	30	30	26	20	13	8
Average minimum temperature	-1	0	2	6	10	14	16	16	13	8	4	1
Kulu/Konya Average Temperature	0	1	5	11	15	20	23	23	18	12	5	1
Average maximum temperature	4	6	11	17	22	26	30	29	25	19	11	6
Average minimum temperature	-4	-4	-1	4	9	13	16	15	11	5	0	-3
Ilgın/Konya Average Temperature	0	2	5	11	15	20	23	23	19	13	6	2
Average maximum temperature	4	6	11	16	21	26	29	29	25	19	11	6
Average minimum temperature	-3	-2	1	5	9	13	16	16	12	7	2	-2
Simav/Kütahya Average Temp.	2	3	6	10	15	20	23	23	19	13	7	3
Average maximum temperature	6	7	11	16	21	26	30	30	26	19	12	7
Average minimum temperature	-2	-1	1	5	9	12	15	16	12	7	3	0
Bolvadin/Afyonkarahisar Average T.	0	2	5	11	15	19	23	22	18	12	6	2
Average maximum temperature	4	6	10	16	21	26	29	29	25	18	11	6
Average minimum temperature	-3	-2	1	5	9	12	15	15	11	7	2	-2
Yalova Average Temperature	6,6	7	8,4	12,2	16,8	21,1	23,5	23,5	20,1	16,1	12,1	8,8
Average maximum temperature	10	10,7	12,6	16,9	21,4	25,9	28,4	28,5	25,1	20,7	16,4	12,3
Average minimum temperature	3,3	3,6	4,6	8	12,2	16	18,1	18,4	15,2	12	8,3	5,5
Bilecik Average Temperature	2,5	3,7	6,4	11,5	16,1	19,9	22,1	22,1	18,5	13,9	9,2	4,7
Average maximum temperature	6	7,9	11,4	17,1	22	25,8	28,4	28,7	24,9	19,4	13,6	8,1
Average minimum temperature	-0,3	0,4	2,4	6,7	10,9	14,2	16,3	16,5	13,2	9,6	5,6	1,9
Tekirdağ Average Temperature	4,9	5,5	7,3	11,7	16,7	21,1	23,7	23,9	20,3	15,7	11,3	7,3
Average maximum temperature	8,1	9	11	15,7	20,6	25,3	28,1	28,3	24,5	19,5	14,8	10,5
Average minimum temperature	2	2,5	4,1	8,1	12,7	16,7	19,1	19,4	16,2	12,1	8,2	4,4
Akşehir/Konya Average Temp.	0	2	6	11	15	20	23	23	18	13	6	2
Average maximum temperature	4	6	10	15	20	25	29	29	25	18	11	6
Average minimum temperature	-3	-2	1	5	9	13	16	16	12	7	2	-1
Beyşehir/Konya Average Temp.	0	1	5	10	14	19	22	22	18	12	6	2
Average maximum temperature	4	6	10	15	20	25	28	28	25	18	11	6
Average minimum temperature	-3	-2	1	5	9	13	16	15	11	7	2	-2
Seydişehir/Konya Average Temp.	1	2	5	10	14	19	23	22	18	12	6	2
Average maximum temperature	5	6	10	15	20	25	28	29	25	19	12	6
Average minimum temperature	-3	-2	1	5	9	13	16	16	11	7	2	-1
Yunak/Konya Average Temperature	-1	0	4	9	14	18	22	22	17	11	5	0
Average maximum temperature	3	5	10	15	20	25	28	28	24	17	10	4
Average minimum temperature	-5	-4	-1	3	7	11	15	14	10	5	0	-3
Sivrihisar/Eskişehir Average Temp.	-2	0	4	9	14	18	22	21	17	11	4	0
Average maximum temperature	2	5	10	15	20	25	28	28	24	17	10	4
Average minimum temperature	-5	-4	-2	3	7	11	14	14	9	4	-1	-4
Keskin/Kırıkkale Average Temp.	-2	0	4	9	14	18	22	21	17	11	4	0
Average maximum temperature	3	5	10	15	20	25	29	28	24	18	11	5
Average minimum temperature	-6	-6	-3	2	6	10	13	13	8	3	-2	-5
Nevşehir Average Temperature	-0,2	0,9	4,9	10,1	14,5	18,3	21,3	21,2	17,3	12,1	6,7	2,1
Average maximum temperature	3,9	5,5	10,2	15,9	20,6	24,8	28,5	28,6	24,5	18,3	11,8	6,2
Average minimum temperature	-3,7	-2,7	0,6	5,1	8,8	11,6	13,6	13,5	10,4	6,8	2,4	-1,3
Bafra/Samsun Average Temp.	7	7	8	12	16	21	24	24	21	17	12	9
Average maximum temperature	10	10	12	15	19	24	27	27	24	19	15	12
Average minimum temperature	5	4	6	9	13	17	20	20	17	14	9	6
Van Average Temperature	-3,1	-2,5	1,7	7,8	13,2	18,3	22,3	22,2	17,9	11,4	4,9	-0,3
Average maximum temperature	2	2,7	6,6	12,9	18,6	24	28,3	28,5	24,4	17,4	10,3	4,6
Average minimum temperature	-7,5	-7	-2,7	2,7	7,1	10,9	14,7	14,7	10,8	5,7	0,4	-4,5
Trabzon Average Temperature	7,5	7,3	8,4	11,8	15,9	20,2	23	23,5	20,5	16,7	13,1	9,6
Average maximum temperature	10,9	10,8	12	15,6	19,2	23,2	26	26,6	23,8	20,1	16,6	13,1
Average minimum temperature	4,7	4,4	5,5	8,7	12,9	17,1	20	20,5	17,4	13,7	10,1	6,8
Sinop Average Temperature	7,1	6,8	7,5	10,7	15	19,9	23	23,4	20,2	16,4	12,7	9,4
Average maximum temperature	9,8	9,7	10,6	14,1	18,3	23,1	26	26,4	23,2	19,3	15,6	12,2
Average minimum temperature	4,7	4,3	5	8	12,2	16,9	19,9	20,4	17,4	13,8	10,1	6,9
Edremit/Van Average Temperature	-3	-2	2	8	13	18	22	22	18	12	5	0
Average maximum temperature	2	2	6	12	17	23	27	27	23	16	9	4
Average minimum temperature	-7	-6	-2	4	8	12	16	16	11	6	1	-4
Tatvan/Bitlis Average Temperature	-6	-4	1	7	12	18	22	22	17	10	3	-3
Average maximum temperature	-2	0	4	11	16	23	27	27	23	15	7	1
Average minimum temperature	-9	-8	-3	2	7	11	15	15	10	5	-1	-6
Ahlat/ Bitlis Average Temperature	-6	-4	1	7	12	17	22	21	17	10	3	-3
Average maximum temperature	-1	0	5	12	17	23	27	28	23	16	8	1
Average minimum temperature	-10	-8	-3	2	7	11	14	14	9	4	-1	-7

Table 2. Annual temperature data of cities belonging to the Cfa climate type

CFA / Cities	January	February	March	April	May	June	July	August	September	October	November	December
Kocaeli Average Temperature	6,2	6,7	8,5	13	17,6	21,7	23,8	24	20,5	16,2	12,2	8,4
Average maximum temperature	9,7	10,6	13,2	18,5	23,3	27,5	29,6	29,8	26,2	21,1	16,5	12
Average minimum temperature	3,2	3,4	4,8	8,5	12,8	16,6	19	19,3	16,1	12,5	8,8	5,5
Karabük Average Temperature	2,8	5,4	7,8	12,1	16,6	20,2	23,1	24	19,7	14,3	8,6	4,5
Average maximum temperature	7,9	11,6	14,8	20,2	24,4	27,8	31,3	32,7	28,4	21,7	15,3	9,5
Average minimum temperature	-0,5	1,2	2,8	5,8	10,6	14,5	16,1	16,9	13,2	9,2	4,1	1,4
Sakarya Average Temperature	6,2	6,8	8,7	12,9	17,4	21,4	23,5	23,4	19,8	15,6	11,8	8,3
Average maximum temperature	9,9	11,2	13,8	19	23,6	27,6	29,5	29,6	26,4	21,5	16,9	12,1
Average minimum temperature	3	3,4	4,6	8,2	12,3	16	18	18,1	14,6	11,2	7,7	5,1
Düzce Average Temperature	3,7	5,2	7,6	12,2	16,5	20,3	22,4	22,3	18,7	14,2	9,5	5,8
Average maximum temperature	8,3	10,5	13,6	19	23,4	27,1	29,1	29,3	26	20,9	15,7	10,4
Average minimum temperature	0,5	1,4	3,5	7,2	11,3	14,8	16,9	17	13,5	9,8	5,3	2,5
Çankırı Average Temperature	-0,5	1,2	5,6	11,2	15,8	19,7	23,1	22,9	18,1	12,2	5,8	1,6
Average maximum temperature	3,7	6,3	11,9	18	23	27,1	31,1	31,4	26,7	20,3	12,4	5,7
Average minimum temperature	-3,9	-3,1	-0,1	4,5	8,7	11,9	14,2	14	9,7	5,2	0,6	-1,8
Pazar/Tokat Average Temp.	2	4	8	13	16	20	23	23	19	14	8	4
Average maximum temperature	6	8	13	18	23	27	29	30	26	20	13	8
Average minimum temperature	-1	-1	2	6	10	13	16	16	13	8	3	0
Bartın Average Temperature	4,1	4,9	7,3	11,4	15,8	19,8	22	21,9	18	13,9	9,3	5,9
Average maximum temperature	9,4	10,7	13,4	18,1	22,4	26,2	28,3	28,5	25,2	20,7	16,1	11,4
Average minimum temperature	0,4	0,7	2,5	6	10	13,6	15,8	15,8	12,2	8,9	4,7	2,1
Osmancık/Çorum Average Temp.	1	2	6	11	16	20	23	23	19	13	7	3
Average maximum temperature	5	8	12	18	22	26	29	30	26	20	12	7
Average minimum temperature	-3	-2	1	5	9	12	15	15	11	7	2	-1
Emirdağ/Afyonkarahisar Average	0	1	5	10	15	19	22	22	18	12	6	1
Average maximum temperature	4	6	11	16	21	26	29	29	25	18	11	6
Average minimum temperature	-4	-3	0	4	8	12	15	14	10	6	1	-2
Afyonkarahisar Average Temp.	0,3	1,8	5,2	10,4	15	18,9	22,2	22,2	17,9	12,5	7	2,5
Average maximum temperature	4,6	6,5	10,9	16,4	21,3	25,6	29,5	29,7	25,3	19,4	12,9	6,7
Average minimum temperature	-3,5	-2,4	0,1	4,2	8,2	11,3	13,8	13,7	9,9	5,9	1,8	-1,3
İnebolu/Kastamonu Average Tem	7	6	8	12	17	21	23	24	20	16	12	8
Average maximum temperature	9	9	12	16	20	25	27	27	24	20	15	11
Average minimum temperature	4	4	5	9	13	17	20	19	17	13	9	6
Akçakoca/Düzce Average Temp.	7	7	9	13	17	21	23	23	20	16	12	8
Average maximum temperature	10	10	12	17	21	25	27	27	24	20	15	12
Average minimum temperature	4	4	5	9	13	17	19	19	16	12	9	6
Tavşanlı/Kütahya Average Temp.	1	2	5	10	15	19	22	22	18	12	6	3
Average maximum temperature	5	6	10	16	21	25	29	29	25	19	12	6
Average minimum temperature	-2	-2	0	4	8	12	15	15	11	7	2	-1
Tosya/Kastamonu Average Temp.	-1	0	4	9	14	18	21	21	17	12	5	1
Average maximum temperature	3	5	10	16	21	25	29	29	25	18	11	5
Average minimum temperature	-5	-4	-1	3	7	11	13	13	10	6	1	-3
Ordu Average Temperature	7	7	8,2	11,5	15,7	20,4	23,2	23,5	20,3	16,2	12,3	9,1
Average maximum temperature	11	11,1	12,2	15,3	19,3	24,1	26,8	27,4	24,4	20,3	16,6	13,2
Average minimum temperature	4	4	5,2	8,4	12,5	16,8	19,6	20,1	17	13,1	8,9	6
Ünye/Ordu Average Temp.	8	8	9	13	17	21	24	24	21	17	13	10
Average maximum temperature	11	11	12	16	19	24	26	26	23	20	15	12
Average minimum temperature	6	5	7	10	14	18	21	21	18	14	10	7
Bozkurt/Kastamonu Average T.	5	5	7	11	15	20	23	23	19	15	11	7
Average maximum temperature	8	8	11	15	19	24	27	27	23	19	14	10
Average minimum temperature	3	2	4	7	12	16	18	18	15	12	7	4
Samsun Average Temperature	7,2	7,2	8	11,3	15,6	20,3	23,2	23,7	20,3	16,5	12,8	9,5
Average maximum temperature	10,8	11	12,1	15,3	19,1	23,7	26,6	27,2	24	20,4	16,8	13,1
Average minimum temperature	4,2	3,9	4,7	7,8	12,1	16,3	19,2	19,7	16,6	13	9,4	6,4
Rize Average Temperature	6,8	6,8	8,1	11,7	16	20,3	22,9	23,3	20,3	16,4	12,3	8,8
Average maximum temperature	10,7	10,8	11,9	15,4	19,4	23,6	26,0	26,6	24,0	20,4	16,5	12,9
Average minimum temperature	3,8	3,7	4,9	8,4	12,7	16,8	19,6	20,1	17	13,1	9,1	5,8
Giresun Average Temperature	7,4	7,2	8,1	11,3	15,6	20,2	22,9	23,4	20,3	16,5	12,9	9,6
Average maximum temperature	10,7	10,7	11,8	15,1	19	23,5	26,2	26,7	23,7	20	16,4	13
Average minimum temperature	4,7	4,4	5,3	8,5	12,8	17,1	19,9	20,4	17,4	13,8	10,1	6,9
Zonguldak Average Temperature	6,2	6,4	7,5	11,3	15,4	19,6	21,9	22	19	15,4	11,9	8,5
Average maximum temperature	9,3	9,6	10,9	14,9	18,9	23,1	25,2	25,4	22,5	18,8	15,3	11,7
Average minimum temperature	3,6	3,5	4,6	8,1	12,2	16	18,1	18,3	15,5	12,3	8,9	5,8
Amasra/Bartın Average Temp.	7	7	8	12	16	21	23	23	20	16	12	9
Average maximum temperature	9	9	11	15	19	23	26	26	23	19	15	11
Average minimum temperature	4	4	6	9	13	17	20	20	17	13	9	6
Hopa/Artvin Average Temp.	7	7	9	12	16	20	23	23	20	16	12	8
Average maximum temperature	10	10	12	16	19	23	25	26	23	20	15	12
Average minimum temperature	4	4	6	9	13	17	20	20	17	13	9	6
Cide/Kastamonu Average Temp.	6	6	7	11	16	20	23	23	19	15	11	8
Average maximum temperature	8	8	10	14	18	23	25	26	23	18	14	10
Average minimum temperature	4	3	5	9	13	17	19	19	16	12	8	5
Boyabat/Sinop Average Temp.	2	3	6	11	16	20	23	22	19	14	8	4
Average maximum temperature	2	3	6	11	16	20	23	22	19	14	8	4
Average minimum temperature	-2	-1	1	5	9	13	15	15	12	8	3	0

Table 3. Annual temperature data of cities belonging to the Cfb climate type

CFB / Cities	January	February	March	April	May	June	July	August	September	October	November	December
Çorum Average Temperature	-0,3	1,2	5	10,5	15	18,5	21,3	21,4	17,4	12,2	6,4	1,9
Average maximum temperature	4,3	6,5	11,4	17,5	22,2	26	29,1	29,6	25,6	20	13	6,5
Average minimum temperature	-4,3	-3,4	-0,7	3,7	7,6	10,4	12,5	12,7	9,3	5,3	1	-2
Merzifon/Amasya Average T.	0	1	5	10	14	18	20	21	17	12	5	1
Average maximum temperature	4	6	11	16	21	25	27	28	24	18	11	6
Average minimum temperature	-4	-4	-1	3	7	10	13	13	9	5	0	-3
Kastamonu Average Temp.	-1	0,8	4,4	9,6	14,1	17,5	20,2	20	15,9	10,9	5,3	1
Average maximum temperature	3,3	6,2	10,9	16,6	21,3	24,7	27,9	28,2	24	18,2	11,1	5
Average minimum temperature	-4,5	-3,5	-0,9	3,4	7,6	10,5	12,3	12,3	8,9	5,2	0,9	-2,4
Bolu Average Temperature	0,5	1,8	4,7	9,6	14,1	17,3	19,8	20	16,2	11,8	6,9	2,8
Average maximum temperature	5,3	7,2	11	16,6	21,4	24,6	27,4	28	24,3	19,3	13,3	7,5
Average minimum temperature	-3,5	-2,6	-0,5	3,6	7,6	10,4	12,4	12,7	9,5	6,2	2,1	-1,1
Artvin Average Temperature	2,7	3,8	7	11,9	15,9	18,8	20,9	21,2	18,3	14,2	9,1	4,5
Average maximum temperature	6,4	8,4	12,4	17,9	21,9	24,3	25,8	26,4	24	19,7	13,5	8
Average minimum temperature	-0,1	0,5	3	7,2	11,2	14,4	16,9	17,3	14,3	10,3	5,8	1,8
Ilgaz/Çankırı Average Temp.	-2	0	4	9	13	17	21	21	16	11	4	0
Average maximum temperature	2	4	9	15	19	23	27	27	24	17	10	4
Average minimum temperature	-6	-5	-2	3	7	10	13	13	9	4	-1	-4
Çerkeş/Çankırı Average Temp.	-3	-1	2	8	12	16	19	19	15	10	3	-1
Average maximum temperature	1	3	8	13	18	22	25	25	22	16	9	3
Average minimum temperature	-6	-6	-2	2	6	9	12	12	8	3	-1	-4
Devrekani/Kastamonu Average	-2	-1	2	7	11	15	18	18	14	9	4	0
Average maximum temperature	2	3	7	12	17	21	24	24	21	15	9	4
Average minimum temperature	-5	-5	-2	2	6	9	12	12	8	5	0	-3

Table 4. Annual temperature data of cities belonging to the Csb climate type

CSB / Cities	January	February	March	April	May	June	July	August	September	October	November	December
Ürgüp/Nevşehir Average Temp.	-2	0	5	10	14	19	22	22	17	11	5	0
Average maximum temperature	4	6	11	17	21	26	29	29	25	19	11	6
Average minimum temperature	-6	-5	-2	3	7	10	13	12	8	4	-1	-5
Gümüşhane Average Temp.	-1,8	-0,5	3,7	9,3	13,6	17,1	20	20,3	16,4	11,2	5,1	0,5
Average maximum temperature	3	5,3	9,9	16,3	21,2	25,2	28,2	29	25,5	19	10,8	5
Average minimum temperature	-5,4	-4,8	-1	3,8	7,6	10,9	13,8	13,9	10,2	6	1	-2,9
Bozüyük/ Bilecik Average Temp.	0	2	5	10	14	19	21	21	17	12	6	2
Average maximum temperature	4	6	11	16	21	25	28	28	24	18	11	6
Average minimum temperature	-3	-3	0	4	8	12	14	14	10	6	1	-1
Kütahya Average Temperature	0,4	1,8	5	10	14,6	18,2	20,8	20,8	16,7	11,9	6,9	2,5
Average maximum temperature	4,7	6,7	10,8	16,3	21,2	25	28,1	28,5	24,6	19,1	12,9	6,7
Average minimum temperature	-3,3	-2,4	-0,2	3,9	7,9	10,9	13,2	13,2	9,2	5,6	2	-1,1
Kaman/Kırşehir Average Temp.	-1	0	4	10	14	18	22	22	17	11	4	0
Average maximum temperature	3	5	10	16	21	25	29	28	24	18	11	5
Average minimum temperature	-6	-5	-2	3	7	11	14	14	9	4	-1	-4
Sivas Average Temperature	-3,4	-2,1	2,7	9	13,5	17	20	20,2	16,2	11	4,8	-0,6
Average maximum temperature	0,9	2,6	8,1	15,3	20,1	24,1	27,8	28,6	24,7	18,6	10,9	3,7
Average minimum temperature	-7,3	-6,2	-2,1	3,1	6,9	9,6	11,7	11,8	8,1	4,2	-0,2	-4,3
Kızılcahamam/Ankara Average T.	-2	-1	3	8	13	16	20	20	15	10	4	0
Average maximum temperature	2	4	8	14	19	23	26	26	22	16	9	4
Average minimum temperature	-6	-5	-2	2	6	10	13	12	8	4	-1	-4
Hadim/Konya Average Temp.	-3	-2	2	7	11	16	20	20	15	9	3	-1
Average maximum temperature	1	3	7	12	17	23	27	26	22	16	8	3
Average minimum temperature	-7	-6	-3	1	5	9	13	12	8	3	-2	-5
Yozgat Average Temperature	-1,7	-0,6	3	8,5	13,1	16,7	19,6	19,8	15,9	10,8	5,1	0,7
Average maximum temperature	2,2	3,7	8,1	14	18,9	22,7	26	26,5	22,7	17	10,4	4,6
Average minimum temperature	-5,3	-4,6	-1,5	3,2	7,4	10,5	12,9	13,1	9,5	5,4	0,7	-2,6
Gevaş/Van Average Temp.	-4	-3	1	7	12	17	21	21	17	10	4	-1
Average maximum temperature	0	1	5	11	16	22	26	26	22	15	8	3
Average minimum temperature	-8	-7	-3	2	7	11	14	14	10	5	-1	-5
Şebin Karahisar/Giresun Average	-4	-2	2	8	12	16	19	19	15	10	3	-2
Average maximum temperature	0	2	7	13	18	22	25	26	22	16	8	3
Average minimum temperature	-8	-6	-2	2	6	10	13	12	8	4	-2	-5
Keleş/Bursa Average Temp.	-1	0	3	7	12	16	19	19	15	10	4	1
Average maximum temperature	3	4	8	13	18	22	25	25	21	16	9	4
Average minimum temperature	-4	-4	-2	2	6	10	12	12	9	4	0	-3

Table 5. Annual temperature data of cities belonging to the BSk climate type

BSK / Cities	January	February	March	April	May	June	July	August	September	October	November	December
Elazığ Average Temperature	-0,8	0,7	5,6	12	17,2	22,8	27,2	27	22,1	15,1	7,5	1,8
Average maximum temperature	3	5,2	10,9	17,9	23,7	29,8	34,3	34,4	29,5	21,8	12,8	5,6
Average minimum temperature	-3,9	-3	1	6,4	10,9	15,4	19,4	19,3	14,6	9	3,2	-1,2
Malatya Average Temperature	-0,2	1,5	6,8	12,9	18	23,1	27,1	27,1	22,5	15,6	8	2,2
Average maximum temperature	3,2	5,6	11,6	18,4	24	29,6	34	34	29,2	21,4	12,6	5,5
Average minimum temperature	-3,3	-2	2,3	7,5	11,9	16,3	19,9	20	15,6	10	4	-0,7
Iğdır Average Temperature	-3,3	-0,2	6,4	13,1	17,8	22,3	26	25,4	20,5	13,2	6	-0,2
Average maximum temperature	2	5,6	12,6	19,8	24,7	29,6	33,4	33,2	29	21,2	12,8	4,9
Average minimum temperature	-7,9	-5,3	0,3	6,2	10,7	14,5	18,1	17,3	12,4	6,2	0,4	-4,4
Kırıkkale Average Temperature	0,4	2,4	6,8	12	16,7	20,8	24,2	24,2	19,7	13,7	7,1	2,6
Average maximum temperature	4,4	7,3	12,7	18,4	23,3	27,7	31,1	31,2	27,2	20,9	12,9	6,4
Average minimum temperature	-2,7	-1,5	1,6	6,2	10,3	14	16,9	16,8	12,4	7,6	2,4	-0,5
Karaman Average Temperature	0,6	2	6,3	11,6	16,1	20,2	23,4	23,1	18,9	13,1	7,1	2,7
Average maximum temperature	5,6	7,4	12,5	18,2	23,3	27,7	31,1	31,1	27,2	20,8	13,7	7,7
Average minimum temperature	-3,7	-2,6	0,6	5,1	8,9	12,6	15,3	14,8	10,5	5,8	1,3	-1,6
Aksaray Average Temperature	0,5	2	6,4	11,5	16,2	20,2	23,5	23,3	18,8	13,4	7,3	2,7
Average maximum temperature	5,5	7,5	12,5	18,1	23,1	27,1	30,7	30,8	26,7	21	13,8	7,8
Average minimum temperature	-3,6	-2,2	1,3	5,6	9,7	13,1	16,2	16	11,4	6,9	2	-1,3
Polatlı/Ankara Average Temp.	0	1	5	11	15	20	24	23	18	12	6	1
Average maximum temperature	4	6	11	17	22	27	30	30	25	19	11	6
Average minimum temperature	-4	-3	0	4	8	12	16	15	10	5	0	-2
Konya Average Temperature	-0,2	1,5	5,5	11,1	15,9	20,1	23,5	23,4	18,8	12,9	6,5	1,8
Average maximum temperature	4,6	7	11,7	17,5	22,4	26,6	30,2	30,2	26	20,1	13,1	6,7
Average minimum temperature	-4,2	-3,3	-0,2	4,3	8,6	12,7	15,9	15,7	11,1	6	0,9	-2,3
Eskişehir Average Temperature	0	1,6	5,2	9,9	14,9	18,9	21,9	22	17,5	12,1	6	2
Average maximum temperature	4,2	7	11,8	17,2	22,3	26,5	29,8	30,2	26	20,2	12,8	6,5
Average minimum temperature	-3,9	-3,4	-0,9	3,1	7,3	11,1	13,7	13,8	9,2	5	0,2	-1,7
Beypazarı/Ankara Average Temp.	1	2	6	11	16	20	23	23	18	13	6	2
Average maximum temperature	4	7	12	17	22	26	30	30	26	19	12	6
Average minimum temperature	-3	-2	1	5	9	13	16	16	11	7	2	-1
Korkuteli/Antalya Average Temp.	2	3	6	10	15	20	23	23	19	13	7	4
Average maximum temperature	7	8	11	16	20	26	30	30	26	20	13	8
Average minimum temperature	-2	-1	1	4	8	12	16	16	12	7	2	0
Nallıhan/Ankara Average Temp.	0	2	5	10	15	19	22	22	18	12	6	2
Average maximum temperature	4	6	11	17	21	26	29	29	25	19	11	6
Average minimum temperature	-3	-3	0	4	9	12	15	14	10	6	1	-2
Çiçekdağı/Kırşehir Average Temp.	-1	1	5	10	15	19	22	22	18	12	5	1
Average maximum temperature	4	6	11	16	21	26	30	29	25	19	11	6
Average minimum temperature	-5	-4	-1	3	7	11	14	13	9	5	-1	-3
Niğde Average Temperature	-0,3	1,1	5,1	10,6	15,1	19,2	22,5	22,4	18,1	12,6	6,6	1,9
Average maximum temperature	4,9	6,5	10,9	16,8	21,5	25,8	29,4	29,7	25,7	19,7	13,1	7,2
Average minimum temperature	-4,6	-3,4	-0,2	4,4	8,4	11,9	14,8	14,6	10,4	6	1,2	-2,4
Doğubeyazıt/Ağrı Average Temp.	-5	-3	3	9	13	18	22	22	17	11	3	-3
Average maximum temperature	-1	2	8	14	18	24	28	28	23	16	8	2
Average minimum temperature	-9	-7	-2	4	8	12	16	15	11	5	-1	-6
Develi/Kayseri Average Temp.	-3	-1	4	9	13	17	20	20	16	11	4	-1
Average maximum temperature	2	4	9	15	20	24	28	28	24	18	10	4
Average minimum temperature	-7	-6	-2	3	6	10	12	12	8	3	-2	-5

Table 6. Annual temperature data of cities belonging to the BSh climate type

BSH / Cities	January	February	March	April	May	June	July	August	September	October	November	December
Ceylanpınar/Şanlıurfa Average Temp.	6	8	12	17	23	29	33	32	27	21	13	7
Average maximum temperature	11	13	17	23	29	36	40	39	34	27	18	12
Average minimum temperature	2	3	6	11	16	21	25	24	20	15	8	3
Akaçakale/Şanlıurfa Average Temp.	7	8	12	18	23	29	32	32	27	21	13	8
Average maximum temperature	11	13	17	23	30	35	39	38	34	27	18	12
Average minimum temperature	3	4	7	12	17	22	25	25	21	16	9	5
Birecik/Şanlıurfa Average Temp.	6	7	11	17	22	28	32	32	27	20	13	8
Average maximum temperature	10	12	17	22	29	35	39	38	34	26	18	12
Average minimum temperature	3	4	7	11	16	21	25	25	20	15	8	4

Table 7. Annual temperature data of cities belonging to the Dfa climate type

DFA / Cities	January	February	March	April	May	June	July	August	September	October	November	December
Oltu/Erzurum Average Temp.	-7	-5	0	7	12	16	19	19	15	9	2	-4
Average maximum temperature	-2	0	6	13	18	22	26	27	23	16	8	1
Average minimum temperature	-12	-11	-5	1	6	9	12	12	7	2	-3	-9

Table 8. Annual temperature data of cities belonging to the Dfb climate type

DFB / Cities	January	February	March	April	May	June	July	August	September	October	November	December
Erzurum Average Temperature	-9,1	-7,7	-2,4	5,4	10,7	14,9	19,2	19,5	14,8	8,2	1,2	-5,7
Average maximum temperature	-3,9	-2,3	2,6	11,0	16,9	21,8	26,6	27,3	22,7	15,2	6,9	-0,9
Average minimum temperature	-13,9	-12,6	-7	0	4,3	7,3	11,1	11,2	6,4	1,7	-3,8	-10,2
Kars Average Temperature	-10,8	-8,9	-2,8	5,2	10,3	14	17,6	17,9	13,7	7,4	0,5	-6,8
Average maximum temperature	-4,8	-2,7	2,9	11,4	16,9	21,2	25,6	26,4	22,3	15,1	6,9	-1,3
Average minimum temperature	-16,3	-14,7	-8,2	-0,6	3,9	6,7	9,9	9,8	5,4	0,5	-4,7	-11,7
Ardahan Average Temperature	-11,2	-10	-3,4	4,4	9,3	12,8	16	16	12	6,4	-0,2	-7,6
Average maximum temperature	-4,8	-3,1	2,8	10,9	16,3	20,4	24	24,7	20,8	14,4	6,5	-1,8
Average minimum temperature	-16,6	-15,6	-8,7	-1,1	3,2	6	8,9	8,6	4,5	0	-5,4	-12,4

Table 9. Annual temperature data of cities belonging to the Dsa climate type

DSA / Cities	January	February	March	April	May	June	July	August	September	October	November	December
Muş Average Temperature	-7	-5,6	1,2	9,2	14,8	20,1	25	25,1	20,2	12,8	4,8	-2,5
Average maximum temperature	-2,9	-1,1	6	14,9	21,3	27,6	33	33,2	28,4	20	10,1	1,3
Average minimum temperature	-10,6	-9,4	-2,7	4,4	8,9	12,8	17,1	17,1	12,4	7	0,7	-5,6
Hakkari Average Temperature	-4,5	-3	2,2	8,3	14,2	20,2	24,7	24,7	20,3	13,1	5,3	-1,3
Average maximum temperature	-0,3	1,4	6,7	13,1	19,5	26,1	31	31,2	26,6	18,7	10	2,8
Average minimum temperature	-7,9	-6,7	-1,6	4,1	9,3	14,2	18,4	18,3	14,1	8	1,3	-4,6
Bitlis Average Temperature	-4,4	-3,4	1	7,3	12,5	18,3	22,7	23	18,5	11,4	4,8	-1,2
Average maximum temperature	-0,5	1	5	12,4	17,8	24,3	29,1	29,7	25	16,8	9,3	2,6
Average minimum temperature	-8,3	-7,4	-2,6	2,7	7,2	11,6	15,7	16,2	11,7	6,6	1,2	-4,5
Tercan/Erzincan Average Temp.	-6	-5	1	7	12	17	21	21	16	9	2	-4
Average maximum temperature	-2	0	6	13	18	24	28	29	24	16	8	1
Average minimum temperature	-11	-9	-4	2	6	9	13	12	8	3	-3	-8
Muradiye/Van Average Temp.	-6	-4	1	7	12	17	21	21	16	10	3	-3
Average maximum temperature	-1	1	5	11	16	22	27	27	22	15	7	1
Average minimum temperature	-10	-8	-3	2	7	11	14	14	10	4	-1	-7

Table 10. Annual temperature data of cities belonging to the Dsb climate type

DSB / Cities	January	February	March	April	May	June	July	August	September	October	November	December
Göksun/Kahramanmaraş Average T.	-2	-1	4	9	14	19	23	23	18	12	5	0
Average maximum temperature	2	4	9	14	20	25	30	30	26	18	10	4
Average minimum temperature	-6	-4	0	4	8	12	15	15	10	6	0	-3
Ağrı Average Temperature	-10,5	-9,1	-3	6	12	16,5	21,1	21,3	16,4	9,3	1,7	-6,3
Average maximum temperature	-5,3	-3,4	2,2	11,8	18,7	24,3	29,3	30,1	25,5	17,4	8	-1,6
Average minimum temperature	-15,5	-14,4	-7,8	0,7	5,3	8,2	12,1	11,9	7	2	-3,5	-10,5
Zara/Sivas Average Temperature	-4	-2	3	9	13	17	21	21	17	11	4	-1
Average maximum temperature	0	2	8	14	19	24	28	28	24	17	9	3
Average minimum temperature	-7	-6	-2	3	7	11	13	13	9	5	-1	-5
Kangal/Sivas Average Temperature	-4	-2	3	9	13	17	21	21	17	10	3	-1
Average maximum temperature	0	2	8	14	19	24	28	29	24	17	9	2
Average minimum temperature	-7	-6	-2	3	7	10	13	13	9	4	-1	-5
Tomarza/Kayseri Average Temp.	-3	-2	3	9	13	17	20	20	16	10	4	-1
Average maximum temperature	2	4	9	14	19	24	28	28	24	17	10	4
Average minimum temperature	-7	-6	-2	2	6	10	12	12	8	3	-2	-5
Hınıs/Erzurum Average Temp.	-8	-6	-1	6	11	16	21	21	16	9	1	-5
Average maximum temperature	-3	-1	4	12	17	24	29	29	24	16	7	0
Average minimum temperature	-13	-11	-5	1	5	9	13	12	7	2	-4	-10
Erciş/Van Average Temperature	-5	-3	2	8	12	18	22	22	17	11	4	-2
Average maximum temperature	-1	1	6	12	17	23	27	27	22	16	8	2
Average minimum temperature	-9	-7	-2	3	8	11	15	15	11	5	-1	-6
Yüksekova/Hakkari Average Temp.	-5	-4	1	6	11	17	21	20	15	9	2	-3
Average maximum temperature	0	1	6	11	17	23	27	27	23	16	8	2
Average minimum temperature	-9	-8	-4	1	5	9	13	12	7	3	-2	-7
Pınarbaşı/Kayseri Average Temp.	-4	-2	2	8	12	16	20	20	16	10	3	-2
Average maximum temperature	0	2	7	13	18	23	27	28	23	16	8	3
Average minimum temperature	-8	-6	-2	2	6	10	12	12	8	4	-1	-5
Sarız/Kayseri Average Temperature	-4	-3	2	8	12	16	20	20	16	10	3	-2
Average maximum temperature	0	2	7	13	18	23	27	28	23	16	8	2
Average minimum temperature	-8	-7	-2	2	6	9	12	12	8	3	-2	-6
Bayburt Average Temperature	-6,2	-4,9	0,5	7	11,6	15,3	18,8	18,9	14,8	9,4	2,8	-3
Average maximum temperature	-0,8	0,7	6	13,2	18,4	22,9	27,2	27,8	23,7	16,9	8,9	2
Average minimum temperature	-10,4	-9,2	-4	1,8	5,7	8,5	11,2	11,1	7,4	3,6	-1,7	-6,8
Özalp/Van Average Temperature	-7	-5	0	5	10	15	19	19	15	8	1	-4
Average maximum temperature	-2	-1	4	10	15	21	25	25	21	14	6	1
Average minimum temperature	-11	-10	-5	0	4	8	12	12	7	2	-3	-8
Başkale/Van Average Temperature	-8	-7	-2	4	8	14	18	18	13	7	0	-5
Average maximum temperature	-3	-1	3	9	14	20	24	24	20	13	5	0
Average minimum temperature	-13	-12	-7	-2	2	6	10	10	5	0	-5	-10