# Analysis of Library Website Performance for Universities Ranked in Times Higher Education World University Impact Rankings 2024

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## ABSTRACT

*Purpose: This study assesses the web performance of university library websites among the institutions listed in the 2024 Times Higher Education World University Impact Rankings, concentrating on the top 10 universities ranked under Sustainable Development Goal 11 (Sustainable Cities and Communities) on both mobile and desktop devices.*

*Design/methodology/approach: The study uses Google's PageSpeed Insights and WebPage Test to analyze how well these websites perform on both mobile and desktop devices. The study analyzes Total Requests and Page Weight along with mobile and desktop performance based on key metrics like First Contentful Paint (FCP), Largest Contentful Paint (LCP), Total Blocking Time (TBT), Cumulative Layout Shift (CLS), and Speed Index.*

*Findings: On average, the library websites perform much better on desktop than on mobile phones. The average score for desktop websites is 74.17, while for mobile phones it is only 54.00, resulting in a 27.20% overall performance gap. This means that desktop sites perform better than mobile sites, suggesting that most university libraries still need to improve their mobile website performance.*

*Originality/value: This study is original in its contribution to sustainability goals by linking the digital sustainability of higher education institutions to their library website performance. It evaluates the readiness of the university library websites to support sustainable practices.*

**Keywords:** Impact Ranking, SDGs, Sustainability, Library Websites, PageSpeed Insights, Web Performance, Times Higher Education.

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## 1. Introduction

Sustainability is a key global challenge affecting not only the environment and society but also the role of educational institutions. Sustainable development goals, or SDGs, include targets like climate action (SDG 13) and sustainable cities and communities (SDG11), which highlight the need to protect the environment, reduce carbon footprints, and adopt green technologies. Higher education institutions can reduce their environmental impact and promote sustainable behavior among faculty, students, and the public by implementing sustainable campus operations and practices. Sustainability-focused graduates can support sustainability policies and initiatives, encourage sustainable behavior and practices, and support sustainable development in their communities and professions (Abo-Khalil, 2024). Universities now play an important role in promoting and advancing sustainable development initiatives and supporting students and researchers. Energy-efficient technologies are being implemented in many university libraries, which are also mostly becoming digital platforms. The transition of libraries to digitization and the provision of electronic resources greatly aid in reducing the amount of paper

used and lowering carbon emissions to create a more sustainable environment. This study examines the key performance indicators related to web loading speed and optimisation to assess how these websites contribute to the sustainability efforts of top-ranked universities under SDG 11. Using Google's Page Speed Insights tool, the study examines the top ten university library websites listed in the 2024 Times Higher Education World University Impact Rankings.

### 1.1 Sustainable Cities and Communities (SDG 11)

Rapid urbanization and economic growth have made the need for resilient and sustainable cities urgent. Sustainable Cities and Communities (SDG 11), one of the goals of SDGs focuses on creating cities that are safe, welcoming, and environmentally friendly. This goal is about ensuring that infrastructure and buildings are constructed in ways that don't harm the environment or people. It also entails more green parks, public spaces for all, more affordable housing, and improved public transit. SDG 11 is all about improving rubbish, cutting down on waste and air pollution, and making better use of resources. It also entails employing sustainable energy sources, such as wind and solar power, and conserving energy and water. Building an efficient and safe infrastructure capable of withstanding natural disasters, including fires, floods, and storms, is also crucial. These SDG objectives are designed to improve the environment and provide people with a better place to live, where they can breathe clean air and lead healthier lives. In addition to these goals, one must put forth effort to improve our planet. Whether in the industrial or educational sector, all sectors and industries should bear equal responsibility for creating a better world. Universities contribute to these efforts by transitioning to digital resources, thus reducing their carbon footprint. However, the success of these digital platforms also depends on their usability and performance. The libraries at every university are crucial because they offer a wealth of resources for research and study. Their shift to digitalization has the potential to contribute to a more sustainable environment. However, digitization alone is insufficient; these websites' functionality is equally important. Understanding how long it takes to serve customers is crucial. A slow-loading library website may hinder access to essential academic resources, affecting both learning and research.

## 2. Review of Literature

Several studies note that website performance is a key enabler in digital sustainability. Lowering website performance leads to higher energy consumption and a poorer user experience due to reduced resource efficiency (George et al., 2020). In higher education, library websites serve as information providers whose efficient operation supports SDG goals by promoting inclusiveness and enabling fair access to information (Del/ Río Castro et al., 2021; Paiola et al., 2021). Several studies examine the performance and usability of university websites. Kaur et al. (2016) note that important performance attributes, such as speed, load time, SEO optimisation, and other metrics, are tested using automated tools, including Pingdom, GTMetrix, and Site Speed Checker, so that universities can identify specific areas for improvement to enhance user experience. Abdulla et al. (2023) propose a comprehensive heuristic evaluation model for the usability evaluation of the most visited websites of higher education institutions in Iraq. Sharma and Choudhary (2021) used the Web Accessibility Evaluation Tool (WAVE) to test the main pages of the top fifty University Library websites for accessibility errors and related issues. The top fifty Indian universities were selected as institutions of national significance in India's educational system based on the NIRF rankings. Shayegan and Kouhzadi (2020) find that SEO metrics, such as Backlinks and PageRank, enhance university websites; therefore, strong SEO outreach would lend higher visibility and academic prestige to those sites. The studies focus on sites with poor performance at universities, the need to improve usability, and the need to enhance SEO. Verma and Jaiswal (2020) conducted a study on the websites of the top 30 medical colleges in India using PageSpeed Insights (PSI). In order to give them a deep performance analysis, the study delves into the two prominent PSI metrics, the desktop PageSpeed Insights score and the mobile PageSpeed Insights score, of these thirty websites. Xilogianni et al. (2022) analyse 121 library, archive and museum websites using Google's PageSpeed Insights, finding that the desktop version performed better than the mobile. Studies emphasise that key metrics such as FCP and TBT affect overall speed, highlighting the need for optimisation to improve the user experience.

## 3. Research Statement

This study provides an overview of SDG11 (Sustainable cities and communities), by examining the library website of top-ranked universities in the 2024 Times Higher Education World University Impact Ranking It analyze factors such as Total Requests and Page Weight along with the key performance metrics such as First Contentful Paint (FCP), Largest Contentful Paint (LCP), Total Blocking Time (TBT), Cumulative Layout Shift (CLS), and Speed Index using Google's PageSpeed Insights and WebPageTest. Furthermore, the study identifies common performance issues affecting these websites and compares their performance across mobile and desktop platforms.

## 4. Scope and Limitation

Using Google's diagnostic tools, PageSpeed Insights and WebPage Test, this study examines how well the library websites of the highest-ranked universities in the 2024 University Impact Ranking perform on desktop and mobile devices. Every

performance metric is examined on both the desktop and mobile domains, including First Contentful Paint (FCP), Largest Contentful Paint (LCP), Total Blocking Time (TBT), Cumulative Layout Shift (CLS), and Speed Index. Only a small number of highly regarded universities were included in the study, which limits the applicability of the findings to all universities offering higher education. The study makes use of Google PageSpeed Insights and WebPage Test, which only analyse a portion of the metrics and may overlook some crucial measurements. It does not demonstrate how a website functions across devices and scenarios. Since the data was gathered all at once, the results are just an overview of the present moment. The outcome might change if the university updates or improves its library website's functionality in the future.

## 6. Data Analysis and Interpretation

### 6.1 Top-Ranked Universities under SDG 11 in THE Impact Rankings 2024

| University Name | Location | Library website Link | Rank |
|---|---|---|---|
| The University of Manchester Library | Manchester, United Kingdom | https://www.library.manchester.ac.uk | 1 |
| Arizona State University | United States | https://lib.asu.edu | 2 |
| Simon Fraser University | Burnaby, Canada | https://www.sfu.ca/learning/library.html | 3 |
| University of Victoria | Victoria, Canada | https://www.uvic.ca/library/index.php | 4 |
| Massey University | Palmerston North, New Zealand | https://www.massey.ac.nz/study/library/ | =5 |
| Michigan State University | East Lansing, United States | https://lib.msu.edu | =5 |
| Queen's University | Kingston, Canada | https://library.queensu.ca | 7 |
| The Hong Kong University of Science and Technology | Kowloon, Hong Kong SAR China | https://library.hkust.edu.hk | 7 |
| Florida International University | Miami, United States | https://library.fiu.edu | 8 |
| Near East University | Nicosia, Northern Cyprus | https://neu.edu.tr/academic/grand-library/?lang=en | 8 |
| University of Glasgow | Glasgow City, United Kingdom | https://www.gla.ac.uk/myglasgow/library/ | 9 |
| Monash University | Clayton, Australia | https://www.monash.edu/library | 10 |

Table 1. Top-Ranked Universities under SDG 11 in THE Impact Rankings 2024

***Note: Due to tied ranks, the table includes more than ten institutions.***

The 2024 Times Higher Education Impact Rankings for SDG 11: Sustainable Cities and Communities highlight a diverse range of universities worldwide leading the charge in urban sustainability, as shown in Table 1. While the rankings are limited to the top 10 positions, ties in rank have resulted in 12 universities being included. At the top of the list, the University of Manchester Library stands out as a global leader, emphasising the role of higher education in driving sustainable urban planning, climate action, and environmental responsibility. Arizona State University and Simon Fraser University came in second and third, respectively. While the University of Victoria came in fourth. Massey University and Michigan State University share the fifth position and focus on contributing valuable knowledge for sustainable urban development. Queen's University and the Hong Kong University of Science and Technology share the seventh position. Florida International University and Near East University jointly ranked eighth, while The University of Glasgow ranked ninth and Monash University ranked tenth, all showcasing global leadership in the effort to make cities more sustainable, equitable, and resilient to climate challenges.

### 6.2 Website Performance Scores on Desktop and Mobile

| University | Desktop Score | Mobile Score | Difference (D-M) | Difference (%) |
|---|---|---|---|---|
| The University of Manchester | 65 | 48 | 17 | 26.15% |
| Arizona State University | 88 | 51 | 37 | 42.05% |
| Simon Fraser University | 64 | 54 | 10 | 15.63% |
| University of Victoria | 86 | 42 | 44 | 51.16% |
| Massey University | 86 | 60 | 26 | 30.23% |
| University of Michigan | 70 | 66 | 4 | 5.71% |
| Queen's University | 59 | 55 | 4 | 6.78% |
| The Hong Kong University of Science & Technology | 90 | 59 | 31 | 34.44% |
| Florida International University | 45 | 26 | 19 | 42.22% |
| Near East University | 94 | 81 | 13 | 13.83% |
| University of Glasgow | 61 | 42 | 19 | 31.15% |
| Monash University | 82 | 64 | 18 | 21.95% |
| **Average Score** | **74.17** | **54.00** | **20.17** | **27.20%** |

Table 2. Website Performance Scores on Desktop and Mobile

***Note: Difference = Desktop " Mobile; Percentage Difference (%) = (Desktop " Mobile) / Desktop × 100.***

The analysis of library website performance reveals that most university library websites perform better on desktops than on mobile devices, as shown in Table 2. The University of Manchester scored 65 on desktop and 48 on mobile, with mobile performance 26.15% lower. Arizona State University shows a 42.05% difference, with a score of 88 on desktop and 51 on mobile. Simon Fraser University is comparatively balanced, with scores of 64 on desktop and 54 on mobile, showing only a 15.63% gap. The University of Victoria demonstrates the largest discrepancy, where the desktop score of 86 drops to 42 on mobile, a 51.16% decrease. Massey University follows with 86 on desktop and 60 on mobile, a 30.23% difference. The University of Michigan is the most consistent, scoring 70 on desktop and 66 on mobile, with only a 5.71% difference. Queen's University is similarly stable with 59 on desktop and 55 on mobile, a 6.78% gap. The Hong Kong University of Science and Technology records a desktop score of 90 and a mobile score of 59, showing a 34.44% difference. Florida International University has one of the weakest mobile performances, dropping from 45 on desktop to 26 on mobile, a 42.22% gap. Near East University scores 94 on desktop and 81 on mobile, a 13.83% difference. The University of Glasgow scores 61 on desktop and 42 on mobile, a difference of 31.15%, while Monash University records 82 on desktop and 64 on mobile, a gap of 21.95%. The average desktop score is 74.17, and the mobile score is 54.00, resulting in an overall performance difference of 27.20%.

### 6.3 Metric Performance on Mobile Device

As indicated in Table 3, the combined performance data finds a number of problems with websites' loading and interaction. To begin with, regarding First Contentful Paint (FCP), two-thirds of websites are considered slow, as they take a long time to render any content visible to the user, creating a negative first impression. Only 8.33% recover their FCP in fast mode, meaning that very few sites can accomplish a fast initial loading experience. Regarding the Largest Contentful Paint (LCP), a major issue arises: 91.67% of the websites are in slow mode, while none are in fast LCP mode. This means that the sites take too long to load their largest visible content, such as images or key text blocks that affect user engagement and

| Metrics of performance Analysis | Frequency ( Mobile ) | | | | | |
|---|---|---|---|---|---|---|
| | Slow | Percentage | Moderate | Percentage | Fast | Percentage |
| First Contentful Paint | 8 | 66.67% | 3 | 25.00% | 1 | 8.33% |
| Largest Contentful Paint | 11 | 91.67% | 1 | 8.33% | 0 | 00.00% |
| Total Blocking Time | 3 | 25.00% | 3 | 25.00% | 6 | 50.00% |
| Cumulative layout shift | 1 | 8.33% | 3 | 25.00% | 8 | 66.67% |
| Speed Index | 7 | 58.33% | 5 | 41.67% | 0 | 00.00% |

Table 3. Metric Performance on Mobile Device

satisfaction. Total Blocking Time (TBT) shows that while 25% of websites fall into the slow category, causing delays for users before they can engage with the page, another 25% are in the moderate category, experiencing some delays but with less impact. The remaining 50% of the websites demonstrated fast TBT, meaning these sites could become interactive quite quickly. In terms of visual stability, as measured by Cumulative Layout Shift (CLS), 66.67% of the websites fall under fast CLS, meaning that most of the websites provide a stable visual experience during page load with few unexpected movements. Still, 25% of these have a moderate CLS, suggesting that minor layout shifts can happen on some websites while they load and may frustrate the user. The final Speed Index (SI) ranking, which measures how fast the visible part of the page loads, showed that 58.33% of sites were slow, meaning more than half of the sites had a delayed visible loading experience. 41.67% were moderate, suggesting a portion of websites load their visible content fairly; however, none of the websites can be marked as fast, pointing to a common problem that seems to prevail across most websites in how quickly the page elements become visible. Overall, the data show notable performance bottlenecks, with slow loading, interactivity challenges, and unsatisfactory rendering of important content as the main issues besetting most websites. Improvements in optimization and user experience will be very much needed.

| Metrics of performance analysis | Frequency (Desktop) | | | | | |
|---|---|---|---|---|---|---|
| | Slow | Percentage | Moderate | Percentage | Fast | Percentage |
| First Contentful Paint | 3 | 25.00% | 4 | 33.33% | 5 | 41.67% |
| Largest Contentful Paint | 3 | 25.00% | 6 | 50.00% | 3 | 25.00% |
| Total Blocking Time | 3 | 25.00% | 2 | 16.67% | 7 | 58.33% |
| Cumulative layout shift | 2 | 16.67% | 2 | 16.67% | 8 | 66.67% |
| Speed Index | 7 | 58.33% | 4 | 33.33% | 1 | 8.34% |

Table 4. Metric Performance on Desktop Device

Desktop performance analysis shows mixed results for website speed and user experience, as illustrated in Table 4. First Contentful Paint (FCP) is relatively good: 41.67% of websites load the first visible content quickly, 25% are slow, and 33.33% fall into the moderate category, indicating room for improvement. In Largest Contentful Paint (LCP), 25% of websites are slow in rendering the largest visible content, which could annoy users; the remaining 50% only fall into the moderate category for LCP speed input, while just 25% are considered fast within this criterion, thus implying that significant optimization efforts are needed for much faster content rendering. Total Blocking Time (TBT) indicates that 58.33% of websites allow fairly

quick user interaction, but 25% still experience delays in becoming interactive; thus, some delays can be disastrous for user engagement, while 16.67% fall under the moderate category. Cumulative Layout Shift (CLS) is, on the other hand, an opportunity because about 66.67% of websites keep their loading in visually stable conditions, which is essential for a smooth user experience, while only 16.67% experience a moderate or slow layout shift. Lastly, the Speed Index (SI) is a concern area, wherein around 58.33% of sites would slow up visible elements loading, which probably could influence how fast a user might think that page loads. Another 33.33% would fall under a moderate category, and only 8.34% mean the fast one. Overall, there is some positivity, especially in maintaining a stable layout and fast initial content load; however, most of the websites leave much to be desired regarding the optimization of large content rendering, interactivity, and visible element loading, which are key factors in enhancing the overall user experience.

### 6.5 Total Requests and Page Weight of University Websites

Total requests and page size by page weight, expressed in kilobytes, are displayed in Figures 1 and 2. Florida International University was the most trafficked, with 170 total requests and also the heaviest site, with 22,400 in page weight, potentially slow to load, and requiring optimization. The University of Victoria ranked second in requests at 135 but maintained an average page weight of 2,746 KB. The Hong Kong University of Science and Technology received 108 requests for rather large pages, 3,300 KB each. Queen's University and The University of Manchester Library had request ranks of 101 and 95, but also had large page weights of 5,495 KB and 4,975 KB, respectively, suggesting that their websites could be made more efficient. Simon Fraser University logged 61 requests with a medium page size of 3,054 KB, while Arizona State University logged 49 requests and a lighter page size of 2,308 KB. Monash University has 44 requests and a page weight of 2,300 KB, placing it in the mid-range. Massey University did quite well with 64 requests and only 1,204 KB in weight. Michigan State University stood out as wonderful, with 50 requests and the lightest site at 1,036 KB, which speaks to the best level of performance and efficiency. Near East University and the University of Glasgow had quite a low number of requests, 39 and 37, respectively, with small sizes at 1,200 KB, which could be an indication of less engagement or simpler sites. Conversely, those with high weights and high traffic, such as Florida International and Queen's, could certainly aim to improve website performance.

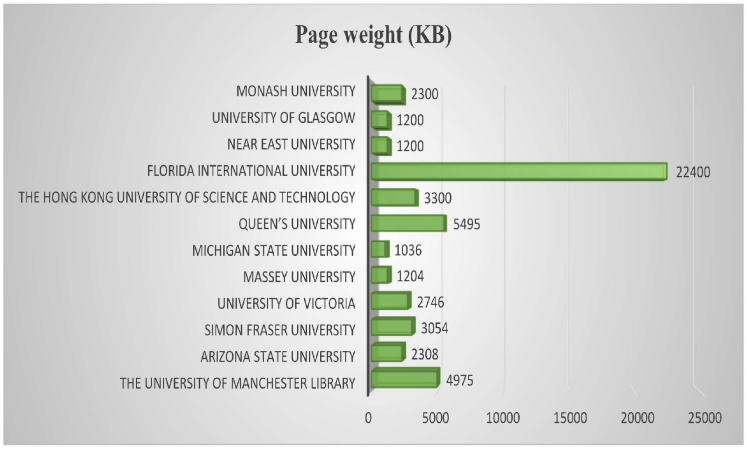


Figure 1. Page Weight

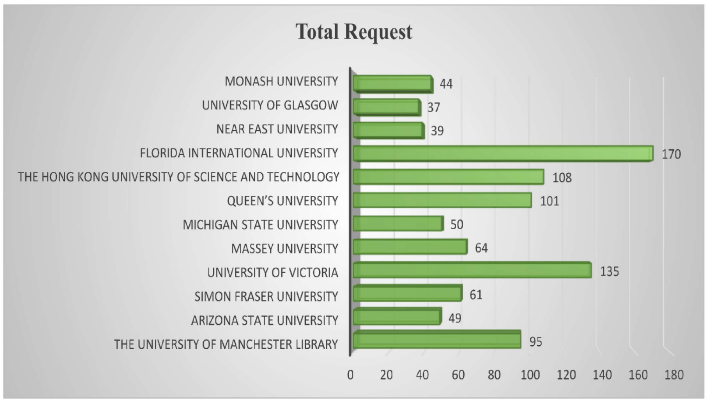


Figure 2. Total Request

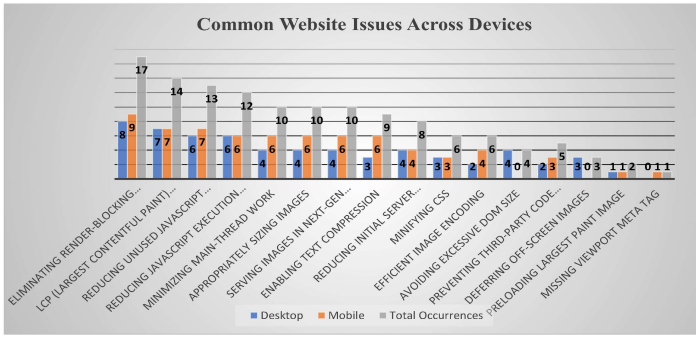


Figure 3. Common Website Issues Across Devices

### 6.6 Common Website Performance Issues across Desktop and Mobile Devices

As illustrated in Figure 3, the problem of removing render-blocking resources is the most common, occurring eight times on desktops and nine times on mobile devices, for a total of 17. This issue arises from an excessive number of CSS and JavaScript files that delay page rendering and need to be addressed to improve load times. LCP delay appears 7 times on both desktop and mobile, for a total of 14 occurrences. It must be addressed as it affects the loading of the main content, leading to a poor user experience. Reducing unused JavaScript and CSS appears 6 times on each platform, totaling 13 occurrences. Removing unnecessary code is essential to enhancing website efficiency and speed. Minimizing main-thread work occurs 4 times on desktop and 6 times on mobile, with a combined total of 10. Optimizing this can improve interactivity and responsiveness. Reducing JavaScript execution time appears 6 times on each device, for a total of 12 occurrences. Appropriately sizing images and serving images in next-gen formats each appear 4 times on desktop and 6 times on mobile, for a total of 10 occurrences each. Text compression appears 3 times on desktop and 6 times on mobile, with a total of 9 occurrences. Minifying CSS occurs 3 times on each platform, for a total of 6 occurrences. This should be fixed to reduce file size and improve rendering speed. Reducing initial server response time appears 4 times on each device, for a total of 8 occurrences. Optimizing server performance is crucial for reducing delays in loading. Efficient image encoding is referenced 2 times on desktop and 4 times on mobile, for a total of 6. Preventing interference from third-party code is noted 2 times on desktop and 3 times on mobile, reaching a total of 5 occurrences. The excessive size of the DOM is recorded 4 time, while deferring off-screen images appear 3 times. Finally, preloading the largest paint image and missing the viewport meta tag are the least common issues, appearing only once or twice across both platforms. Fixing these minor issues can further optimize loading efficiency and mobile responsiveness.

## 7. Summary and Findings

The overall performance gap is 27.20%, with an average desktop score of 74.17 and a mobile score of 54.00. Specific problems with mobile performance include slow loading, unresponsive interactivity, and high values for both First Contentful Paint and Largest Contentful Paint. Although most sites have stable visual layouts (CLS), rendering speeds and interactivity should be optimized. Desktop performance is a mixed bag for FCP and CLS, while LCP, Total Blocking Time (TBT), and Speed Index (SI) are toward the lower end, making it better than mobile performance but leaving room for improvement in large-content rendering and interactivity. The most frequent concern on both platforms is the elimination of render-blocking resources. Other familiar culprits are LCP delays, unused JavaScript and CSS, and main-thread work. Performance on desktops is generally better; however, it shares these two platforms in optimizing load speed, interactivity, and content rendering.

## 8. Conclusion

Websites frequently behave differently depending on the device. For example, the university library's website behaves differently on desktop and mobile devices. The desktop version typically responds and loads more quickly since it is easier to optimize and runs on more powerful hardware. While some universities have made significant efforts to improve the responsiveness of their desktop and mobile library websites, many still take too long to respond and require further improvement on both platforms. This lag occurs when the browser loads every single element of the page, including unnecessary code and design, forcing the user to wait to access all the content a specific website has to offer. These things sometimes seem acceptable on desktops, where a few seconds of delay is not as obvious or annoying, but on mobile devices, where people demand immediate results, the same website can feel sluggish. Because of this, universities should make their library websites faster on mobile devices by eliminating unnecessary CSS and JavaScripts, which will also fix the website's main issues and make it function more efficiently. These website enhancements will speed up the site's operation, lower the energy required to serve each page, and lessen the library's digital carbon footprint, all of which will contribute to the sustainability goal.

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