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Combining 3D Printing and Knitting: A New Approach to Integrated Saddle Design

Prof. Chupo HO

UoA38

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Combining 3D Printing and Knitting: A New Approach to Integrated Saddle Design

Descriptor

From 2019 to 2021 (ITF project ITP/052/18TI, HKD 2.5M), Prof. Ho led a team focused on creating novel textile structures by integrating conventional knitting loop mechanisms with advanced 3D printing technology. This research was further supported by two subsequent funding projects from 2022 to 2025 by PolyU SFT and RiSports (HKD 700K), which enabled him to apply these innovations to the design of sports equipment. Notably, he observed that 3D printing technology is increasingly used for bespoke bicycle saddles, allowing the separate production of soft layers and rigid bases and rails, rather than producing them as a single printed piece. To address this knowledge gap, Prof. Ho specifically investigated the sandwich structure of knitted spacer fabric – a material commonly used in sports equipment – and enhanced it through the application of 3D printing technology. After conducting finite element simulations and producing multiple prototypes, he successfully integrated these structures into saddle designs to achieve effective shock absorption. Furthermore, he advanced the technology by incorporating continuous carbon fibres and onyx to control rigidity and flexibility, enabling the production of a seamless saddle in a single 3D printing process without manual assembly.

The research methodology included a thorough literature review of market samples, journal articles, and patents. A practice-based approach provided novel insights through design practice. The new lattice structure and modified rail design were evaluated using finite element analysis and a custom hip model for physical testing. Outputs were disseminated through design awards, exhibitions, patents, and an academic article.

Results demonstrated that minor modifications to rail geometry design could reduce maximum absolute stress by 23% and deformation by 49%. The prototype remained structurally intact after ten cycles under a 230 kg load. A preliminary cycling durability test over one year confirmed the prototype's integrity after 1,000 km of road and mountain riding.

(299 words)

Personal Profile: Prof. Chupo HO

Associate Professor Chu-po Ho is a researcher specializing in the design of functional sports apparel/textiles and the development of related equipment. His research focuses on the integration of cutting-edge knitting technologies, the ergonomic design of sports clothing to enhance performance, and the creation of innovative 3D-printed structures through modifications of knitting loop stitch mechanisms.



As Principal Investigator (PI), Professor Ho has submitted three MCOs. In MCO 1, he led a team in creating a flexible buoyant fabric using a modified inlay knitting technique. This fabric is notable for its flexibility and bendable qualities, which significantly reduce the bulk of conventional swimming devices. In MCO 2, he advanced this buoyant fabric's application in designing a range of buoyant swimming vests for children. The design features adjustable buoyancy to accommodate varying swimming abilities among children. The development stages of the vests and their rating of wearer trials were also reported. MCO 3 was a collaborative project funded by the School of Fashion and Textiles and the Research Institute of Sports at The Hong Kong Polytechnic University, amounting to HKD 700,000. In this initiative, Professor Ho directed another team in developing experimental 3D-printed lattice-structured materials inspired by the high compression properties of knitted spacer fabrics. This design was applied to bicycle saddles, crucial for enhancing rider comfort and performance, per the funding scheme's requirements.

In addition to his research publications, patents, and design registrations, Professor Ho has received international recognition for his work, including the 2024 Red Dot Design Award (Winner in Design Concept) and the Gold Award at the 2022 Inventions Geneva Evaluation Days.

Research Questions

1. How can the principles of knitted spacer textile be adapted into 3D-printed sandwich lattice designs?
2. What design strategies ensure the combination of flexible sandwich lattice and rigid continuous carbon fibre rail structure within a single 3D printing process?
3. What is the advancement of applying different 3D printing structures to achieve the production of a bike saddle with a single printing process?
4. How can finite element analysis and experimental testing be applied to evaluate and predict the mechanical performance of the 3D-printed structures?
5. What are the evaluation results regarding the features and reliability of a bicycle saddle produced through this single 3D printing process?

Research Outputs

- 1 x Artefact
- 3 x Patent (China patent x 1; Hong Kong patent x 2)
- 1 x Academic journal article

Chick, M., Ho, C. *, Au, J., Wong, S. & Yip, J. (2025), "Combination of 3D printing and knitting: the loop stitch design and its effects on tensile strength and elongation at break", *International Journal of Fashion Design, Technology and Education*, 18(2), 233–242.

(Published online in Jul 2024)

<https://doi.org/10.1080/17543266.2024.2375652>

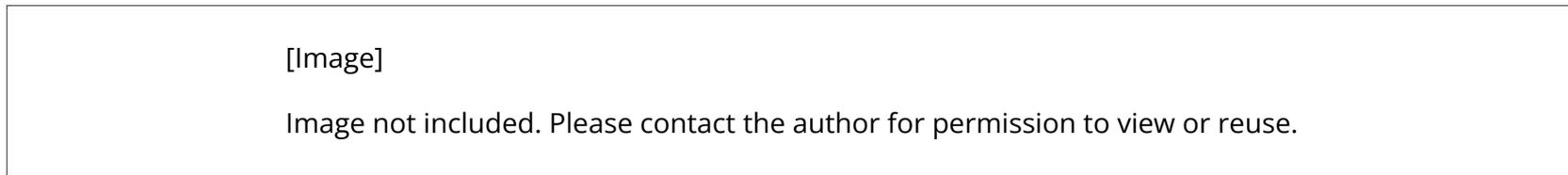


Research Field & Key References

Knitting, Spacer Fabric, and 3D Printing

Knitting is characterized by its high process flexibility and the ability to create diverse fabric structures through interlocking loops of yarn. Over the past 20 years, automated flat and circular knitting machines have become increasingly prevalent in the knitwear and fabric industries, producing fabrics that combine softness and elasticity. In the knitting process, loops of yarn are interlocked using needles to form knit structures. Weft knitting produces horizontal loops across the fabric, whereas warp knitting produces vertical loops along the length of the fabric (Chick et al., 2025). A spacer fabric is a three-dimensional (3D) textile consisting of two separate outer layers joined together and held apart by spacer yarns. These spacer yarns act as linear springs when the fabric is compressed, making them a primary factor in determining the fabric's compressibility. Spacer fabrics have been adapted into a variety of specialized textile products by modifying fabric structures and finishing methods for diverse applications (Rudy & Wardiningsih, 2021). Warp-knitted spacer fabrics are a unique type of textile structure in which spacer yarns are inserted between the front and back knitted layers, forming a 3D fabric. Spacer fabrics are particularly effective at absorbing impact forces and have potential applications in vibration isolation (Yu et al., 2023).

Figure 1 (a – d) illustrates the cross-sections of different weft-knit spacer textiles.



a

b

c

d

Fig. 1 (a-d). Cross-sections of different weft-knit spacer fabrics

Source: Liu, Y., & Hu, H. (2011). Compression property and air permeability of weft-knitted spacer fabrics. *The Journal of The Textile Institute*, 102(4), 366–372. (Reproduced with permission from Taylor & Francis)

Research Field & Key References

Creative Design of Spacer Materials

- According to Li et al. (2009), “the fabric structure parameters can be designed variably, including the pile height, the distribution density of piles, the anisotropy distribution of the yarns in the warp and the weft directions. As reinforcement of composite, the 3-D spacer fabric can be made of glass fiber, carbon fiber, basalt fiber or hybrid yarns” (Figure 2).

- Steffens et al. (2017) developed polymeric composite materials reinforced with auxetic knitted fabrics and evaluated the extent to which the auxetic behaviour of the fibrous reinforcement was transferred to the resulting composite (Figure 3).

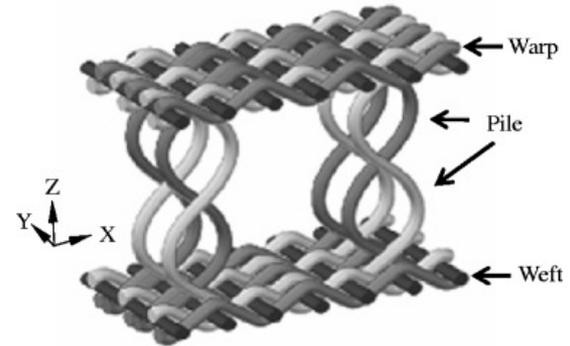


Fig. 2. Configuration of the 3-D spacer fabric

Source: Li, M., Wang, S., Zhang, Z., et al., (2009), “Effect of structure on the mechanical behaviours of three-dimensional spacer fabric composites”, *Applied Composite Materials*, 16, 1–14. (Reproduced with permission from Springer Nature)



Fig. 3. Knitted fabrics impregnated with the resin placed on a raised and planar grid.

Source: Steffens, F., Oliveira, F.R., Mota, C., & Figueiro, R., (2017), “High-performance composite with negative Poisson’s ratio”, *Journal of Materials Research*, 32, 3477–3484. (Reproduced with permission from Springer Nature)

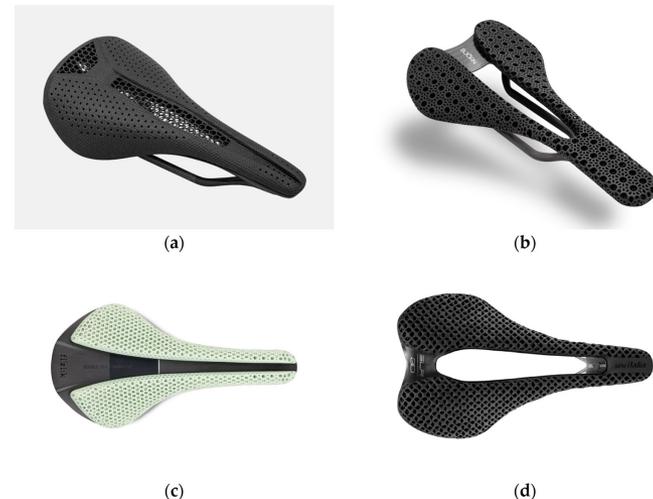
Research Field & Key References

Research Gap of the Bike Saddle Produced by 3D Printing Technology

Three-dimensional (3D) printed bike saddles have gained popularity in recent years, with companies such as Selle Italia, Fizik, Bjorn, and Specialized producing saddles that incorporate 3D-printed padding. Table 1 lists the brand, model and product weight of these 3D printed saddles available in the market. However, current production methods still rely on conventional assembly processes, such as attaching rails and gluing the 3D-printed padding cover to the shell. As a result, commercially available 3D-printed bike saddles offer limited advantages in terms of recyclability and resource efficiency. Moreover, academic journal articles, patents, and market research provide only sparse information on related designs or on how these concepts could be realized through a single, integrated 3D printing process.

To address these research gaps, this study investigated the feasibility of combining innovative 3D printing design concepts with sandwich structures to improve bike saddle design. The goal was to develop a 3D printing process and design concept capable of producing a one-step, “seamless” bike saddle, featuring both a soft top for shock absorption and rigid rails to ensure structural safety.

Figure 4. Examples of 3D printed bike saddle: (a) Specialized S-Works Phenom, (b) Björn Cycles Setka, (c) fizik Antares Verso Evo 00 Adaptive, (d) Selle Italia SLR Boost 3D.



Source: Geyer, S., Schwemmer, J., & Hölzl, C. (2025). Development and Evaluation of Customized Bike Saddle Pads Using Innovative Design for AM Approaches and Suitable Additive Manufacturing Processes. *Applied Sciences*, 15(1), 472.

Research Methods, Prototypes & Materials

Development of Design Process Model

The study focused on developing 3D-printed loop stitches with a sandwich structure, with the creation process and design concept playing a crucial role in their evaluation.

To test the stitch design in a real-world application, a bike saddle was selected as the target sports equipment, in line with the funding party's requirements. The design allows the entire saddle to be 3D-printed in a single process. Appropriate 3D-printed sandwich structures were incorporated into the final prototype, ensuring both functional performance and structural durability.

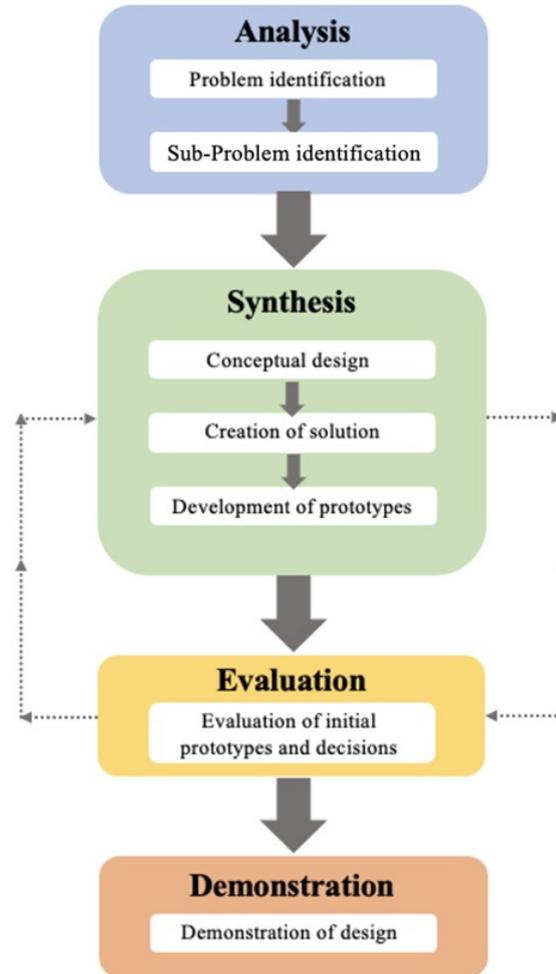


Fig. 5. Design process model for this study

Research Methods, Prototypes & Materials

- This research was a practice-based study, emphasizing the importance of generating new and original forms of knowledge through practice (Candy et al., 2021). In this study, a novel sandwich structure inspired by spacer fabric was developed using 3D printing technology (Figure 6). This design was further extended to create a 3D-printed bicycle saddle, which could be produced in a single 3D printing process without any additional manual assembly.
- After consolidating the design requirements and evaluating the available 3D printing technologies at the university, a commercial 3D printer (Mark Two; Markforged Inc., Watertown, USA) was selected. This printer is capable of printing with Continuous Carbon Fibre (CCF) and Onyx. Carbon fibre was identified as one of the most suitable 3D printing materials to enhance the strength of the saddle rails.
- To evaluate the durability and structural performance of the new rail design, computational simulations using the finite element method and compression tests with a custom-made hip model were conducted (Figure 7). Additionally, a 6-month trial by a cyclist was carried out throughout the development period to assess every version of the prototypes (Figure 8).

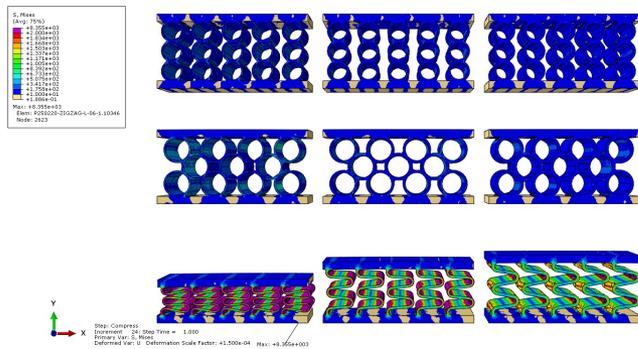


Fig. 6. Computational simulation (finite element method).

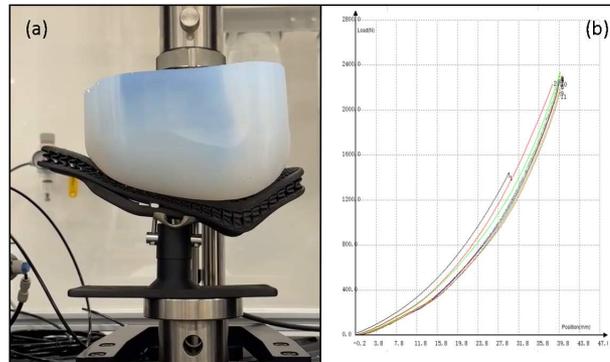


Fig. 7. Compression test with "customized hip model"



Fig. 8. Trial test

Research Methods, Prototypes & Materials

Development of 3D Printed Sandwich Structures

A plain knitting structure (i.e. the single jersey stitch) was studied and developed as the starting point for a 3D-printable textile. Based on the plain single jersey (SJ) structure, the details of the loop stitch design—including its shape and loop size—were examined. Various 3D printing methods were explored, and trial stitches were printed to allow an initial subjective evaluation of printing quality, the combination of 3D printing materials with different hardness levels, and their relationship with physical property test results. Similar to a knitted loop, the basic 3D-printed loop unit consists of a head (H), a side leg (L), and a foot (F), as illustrated in Figure 9.

Figure 10 shows the preliminary result: the 3D-printed knitting loop stitch design. This initial trial provided a foundation for the subsequent design of sandwich spacer structures for 3D-printed objects.

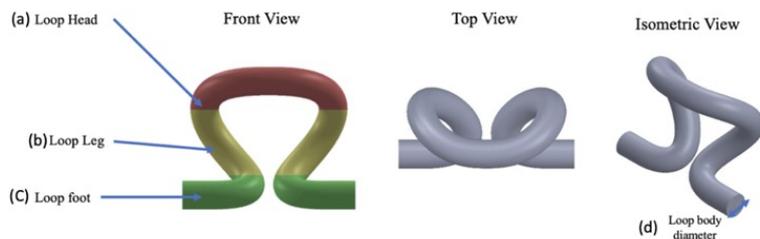


Fig. 9. Parts of the single jersey loop stitch: loop head (a), loop leg (b), loop foot (c), and loop body diameter (d)

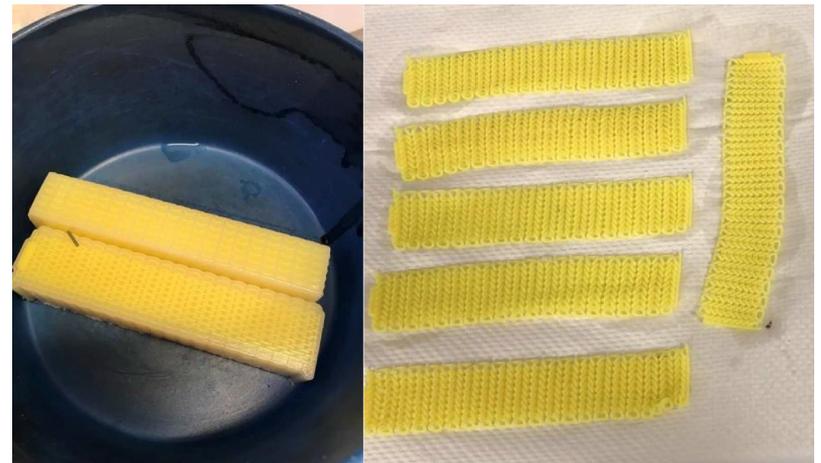


Fig. 10. Trial prototypes for sandwich spacer structure

Research Methods, Prototypes & Materials

Development of 3D Printed Sandwich Structures

Inspired by warp-knitted and weft-knitted spacer fabrics, various sandwich structures were designed based on the principles of spacer fabric and the internal construction of mattresses (Figure 11). The feasibility of achieving high-quality prints for the final prototypes was also considered. Finite element (FE) simulations were conducted to evaluate the effectiveness of the structural designs in terms of their compressive performance and potential for pressure relief.

The simulation results indicate that the zigzag structure exhibits the greatest deformation under both top-surface compression and side-loading tests.

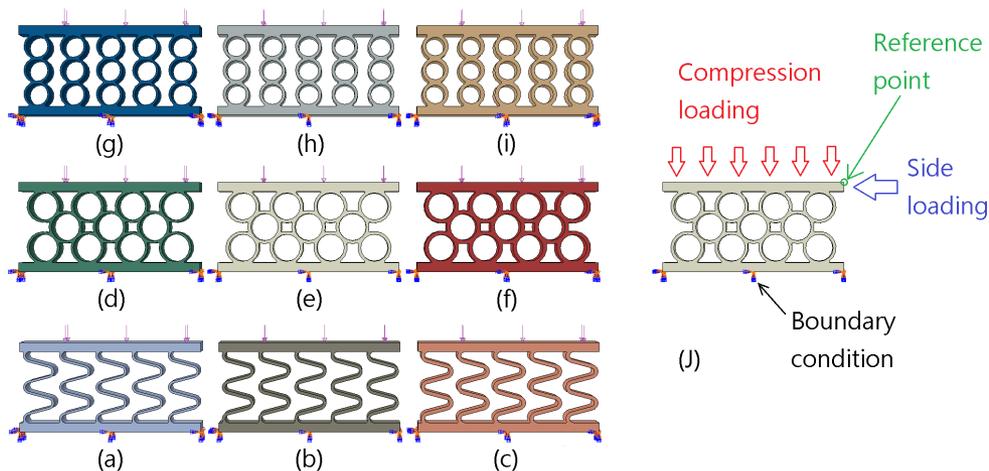


Fig. 11. Designs of workpiece. (a) Zigzag with 0.6-mm wall thickness, (b) zigzag with 0.8-mm wall thickness, (c) zigzag with 1.0-mm wall thickness, (d) cross-linked circles with 0.6-mm wall thickness, (e) cross-linked circles with 0.8-mm wall thickness, (f) cross-linked circles with 1.0-mm wall thickness, (g) stacked circles with 0.6-mm wall thickness, (h) stacked circles with 0.8-mm wall thickness, (i) stacked circles with 1.0-mm wall thickness, and (j) illustration of boundary condition, loading condition, and reference point for computational simulation

Research Methods, Prototypes & Materials

Development of 3D Printed Sandwich Structures

A reference point was established at the midpoint of the upper right edge of the workpiece (j). Design (f), which showed the least deformation under lateral force, was selected as the reference deformation unit.

Among the tested configurations, the zigzag designs exhibited the greatest overall deformation. The stacked-circle design demonstrated lower deformation under compression loading but was more susceptible to side loading. In contrast, the cross-linked circle design showed the opposite behaviour (Figures 12 and 13).

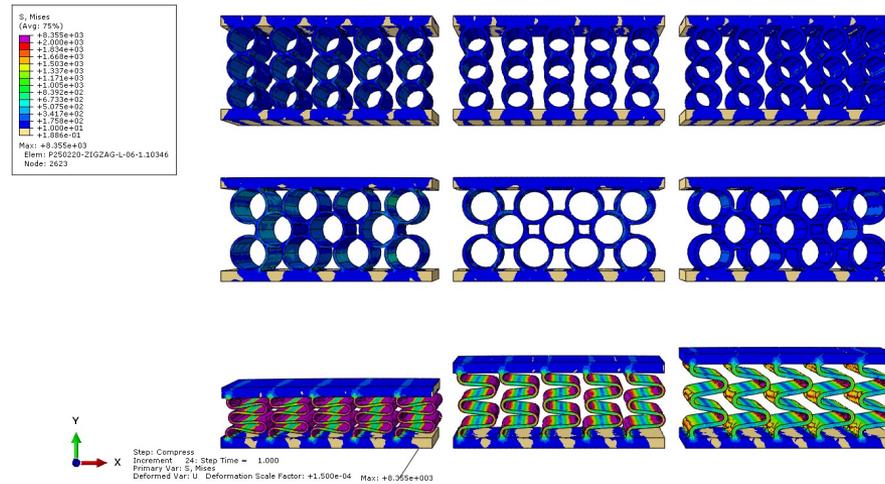


Fig. 12. Computer prediction of workpieces under compression loading

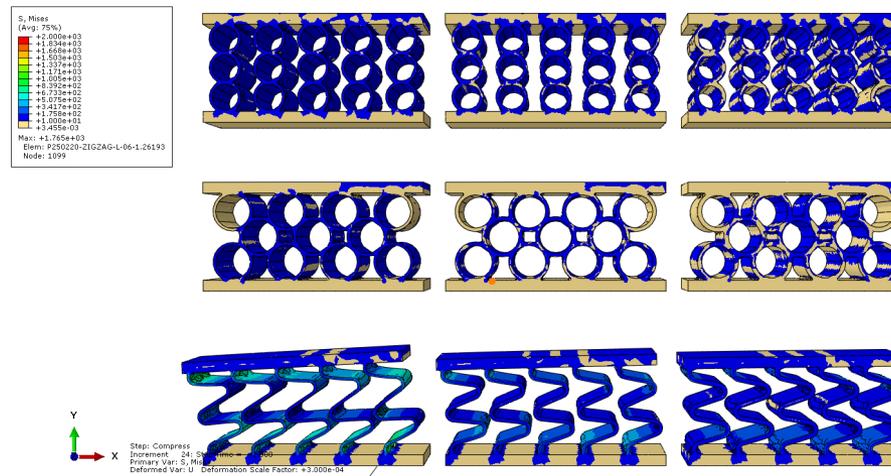


Fig. 13. Computer prediction of workpieces under side loading

Research Methods, Prototypes & Materials

Development of 3D Printed Sandwich Structures

Prototypes of the sandwich structure were developed, drawing inspiration from the construction of spacer fabrics and the innerspring patterns of mattresses.

A spacer fabric is a double-faced fabric produced using a double-needle knitting machine and incorporates filler yarns that provide shock absorption. Consequently, spacer fabrics are often referred to as “sandwich” fabrics (Figures 14 and 15).

Importantly, the pattern, volume, and thickness of the filler yarns can be controlled, allowing adjustment of the level of shock absorption provided by the spacer fabric.

In addition, the knitting stitches used in the top and bottom surface layers can be designed to be porous, enhancing both air and water permeability.



Fig. 14. Simulation of knitted textile surface



Fig. 15. Simulation of construction of spacer fabric and mattress springs

Research Methods, Prototypes & Materials

Connecting Sandwich Structure to the Inner Part of Bike Padding

Padding design was also a key consideration, as padding directly distributes the rider's weight and absorbs vibrations. To inform the design process, we examined products with similar cushioning functions. Consequently, an internal structure incorporating spacer fabric – commonly used in cushioning for athletic shoes and car seats (Li et al., 2021) – and internal springs, as found in mattresses, was adopted. Multiple zigzag springs were extruded along the vertical plane of the saddle's centreline (Figure 16), with the two ends of each spring connected to the cover and the saddle shell, respectively. Each zigzag spring could be assigned a specific wall thickness, and different regions within a single spring could vary in thickness. This approach enables the production of padding with customized areal support, manufactured efficiently and cost-effectively through 3D printing.

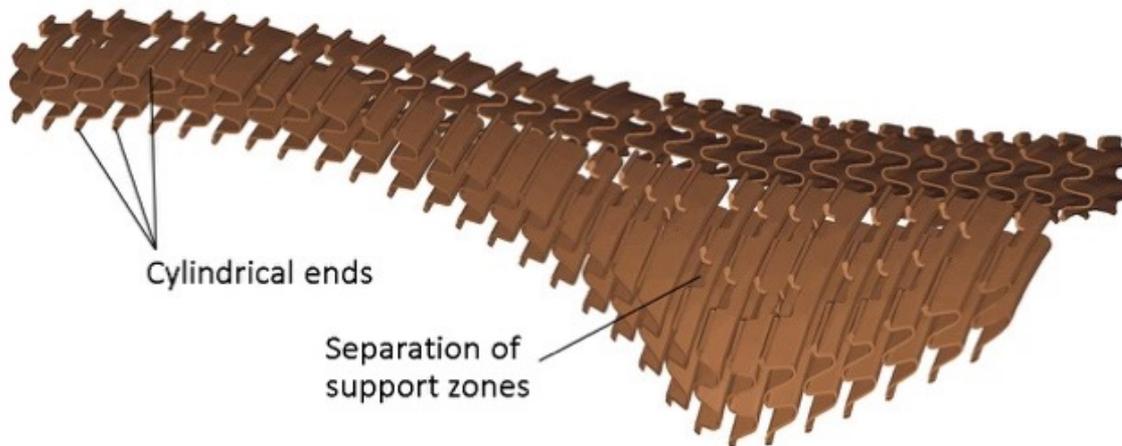


Fig. 16. Design of padding with the inspiration from the construction of spacer fabric

Research Methods, Prototypes & Materials

Connecting Knitted Surface to the Cover Design

To simulate the knitting loop structure of spacer fabric, the initial cover design comprised staggered elliptical cylinder elements (Figure 17a). However, the test print of this design proved too rigid and exhibited only minor deformation under the intended loading conditions. Consequently, the design was modified to consist of multiple “C”-shaped thin plate units, each curved in multiple directions to ensure a smooth surface without sharp edges. A single “C”-shaped unit is shown in Figure 17b, and the corresponding cover is presented in Figure 17c. A known limitation of fused deposition modelling (FDM) printing is the formation of interlayers with relatively low mechanical strength (Coogan & Kazmer, 2020). Because our cover was composed of numerous small, staggered units – similar to the structure of 3D-printed spacer fabrics (Halbrecht et al., 2023) – the interlayer bonding area was, in some cases, too small (Figure 18a), which increased the risk of product failure. To address this issue and enhance interlayer performance, the cover design was slightly modified to substantially improve bond strength without significantly altering the cover’s appearance (Figure 18b).

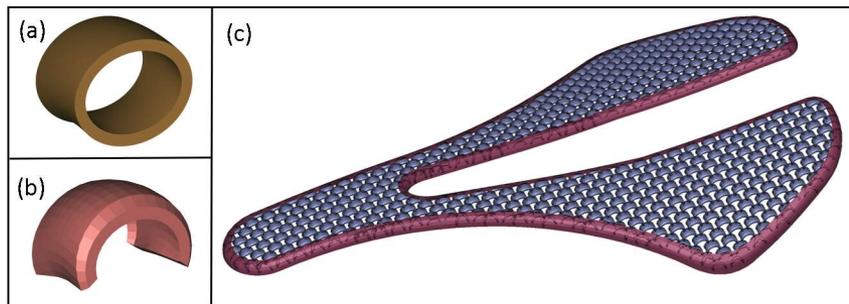


Fig. 17. Designs of bike saddle cover. (a) Elliptical cylinder element. (b) “C”-shaped element. (c) Cover comprising “C”-shaped elements

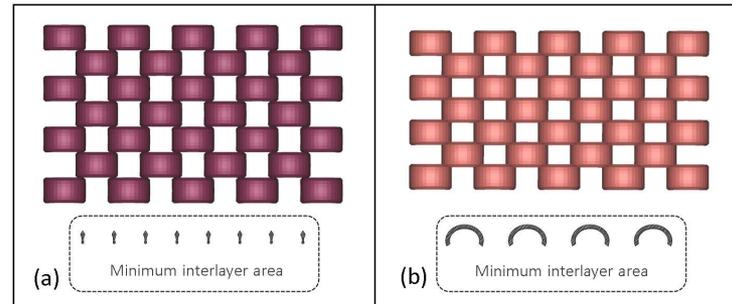


Fig. 18. Comparison of interlayer area designs. (a) Typical staggered-component design. (b) Improved design

Research Methods, Prototypes & Materials

Rails Design with Continuous Carbon Fibre - A Strategy to Print a Seamless Bike Saddle

The original saddle rails (Figure 19a) consisted of two parallel straight rods positioned 44 mm apart, each having either a circular cross-section of 7 mm × 7 mm or a stadium-shaped cross-section of 7 mm × 9 mm or 7 mm × 10 mm, allowing compatibility with a standard seat post. The rails must possess sufficient strength to support the rider's weight and withstand vibrations during cycling. Considering the density and edge distance of CCFs within the extrusion layer, we determined that modifying the rail geometry could be an effective way to increase structural strength. Accordingly, in the subsequent design stage, the thickness at both ends of the rails was increased by 2 mm, and their shape was refined (Figure 19b). This modification increased the rail volume, allowing for a higher concentration of carbon fibre at the ends to enhance overall strength. The added thickness also served to constrain the seat post clamp position, ensuring correct saddle installation. All these design enhancements were integrated to reinforce the overall structure, resulting in an optimized configuration capable of withstanding compression, bending, and torsion during use. Computational simulations were then conducted to evaluate the effectiveness of this optimized design.

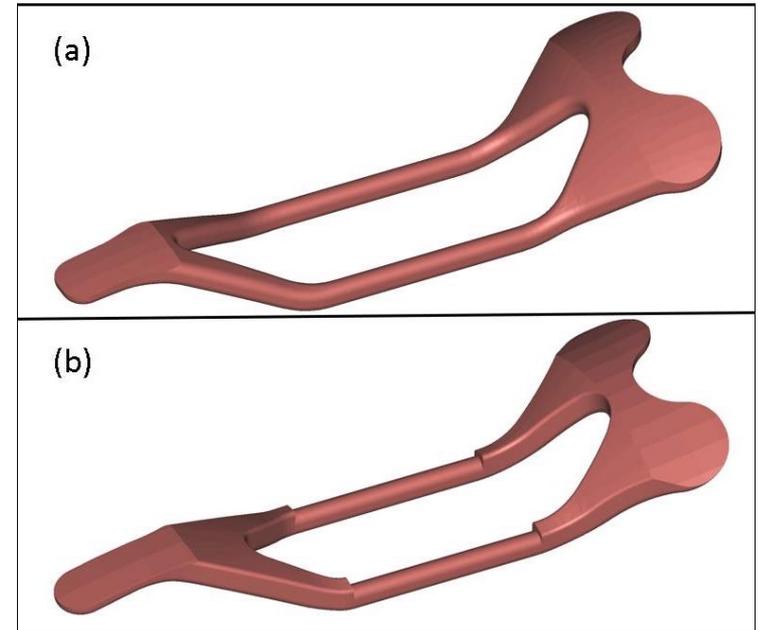


Fig. 19. (a) Original design and (b) thickened-ends design of saddle rails

Research Methods, Prototypes & Materials

Slicing and CCF Placement

A 3D-printed bicycle saddle is shown in Figure 20. As Onyx products exhibit surface roughness parameters of approximately 5–8 microns (Saharudin et al., 2021) and the saddle was printed with a layer thickness of 0.125 mm, the finished product had a semi-lustrous appearance and a smooth tactile feel. The padding structure demonstrated a certain degree of deformability, allowing localized and temporary deformation when pressed with fingers. In contrast, the shell was rigid and showed only minimal deformation under pressure. The CCF-reinforced rails were firm and did not bend when manually tested.

The total weight of the saddle was 171 g, making it one of the lightest bicycle saddles available on the market.

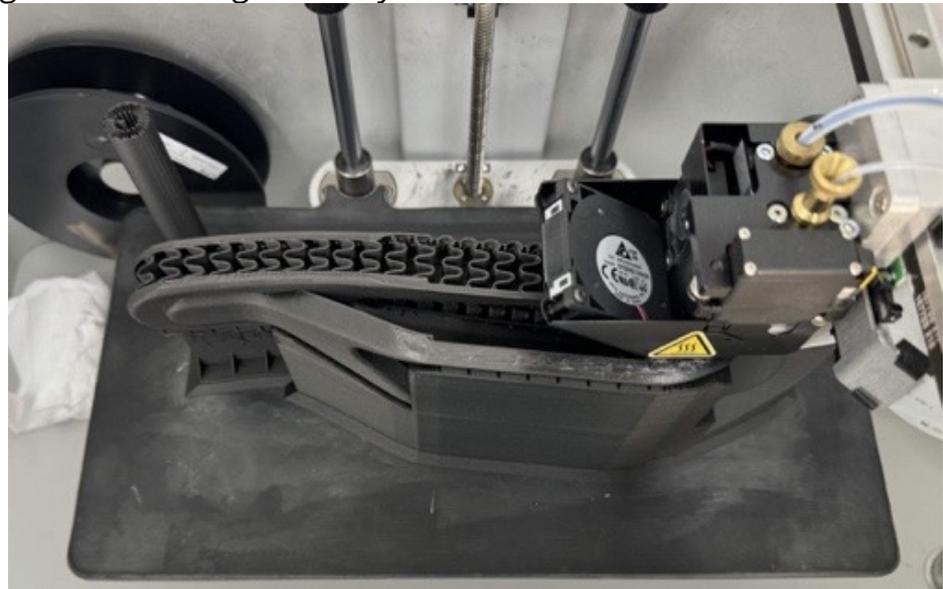
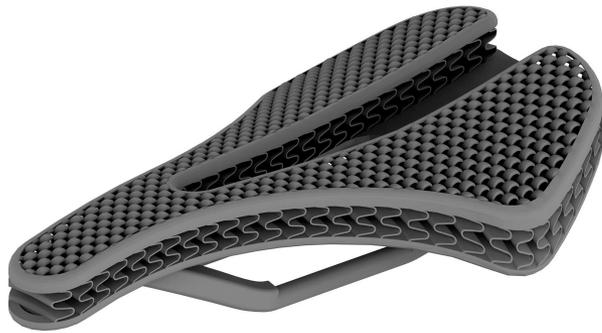


Fig. 20. A bike saddle being printed by a Markforged Mark Two 3D printer

Research Outcomes, Findings & Further Research



Research Outcomes, Findings & Further Research

Finite Element (FE) Method for Product Analysis

The 3D components were modelled using computer-aided design (CAD) software (AutoCAD R13, Autodesk, CA, USA). Material properties were then assigned to individual components in FE software (Abaqus 6.14, Simulia, Dassault Systèmes, France).

The stress distribution diagram (Figure 21) from the FE simulation indicated that the maximum stress on the rail occurred at the top of the straight rod near the saddle clamp. The predicted maximum absolute stress in the original design was 224.6 MPa, while that in the thickened-ends design was 172.1 MPa, representing a 23% reduction. Similarly, the displacement of a point at the end of the rail under loading decreased from 4.62 mm in the original design to 2.37 mm in the thickened-ends design, a 49% reduction. These results demonstrate that the thickened-ends design substantially reduced stress magnitudes in high-stress areas and improved overall structural rigidity. Therefore, the modified design was considered to enhance the rail's strength and minimize internal loads and deformation during use.

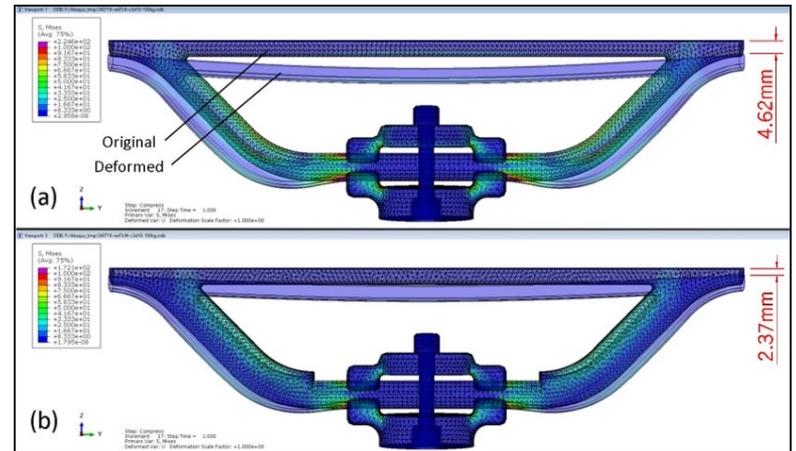


Fig. 21. Finite element method predictions of loading and deformation of rails with (a) original design and (b) thickened-ends design

Research Outcomes, Findings & Further Research

Compression Test for Product Reliability

To evaluate the load-bearing capacity and the ability of the prototype to withstand a rider's weight and impacts during cycling, compression tests were performed using a customized hip model (Figure 22) and a universal testing machine (TSE504C, Wance Testing Machine Company Limited, Shenzhen, China). The hip model was positioned on the saddle such that its sagittal plane aligned with the centreline of the saddle and its ischial tuberosities rested on the widened rear section. Subsequently, the compression plate of the testing machine applied a load to the top of the pelvis, transferring compressive force to the saddle through both the rigid and soft structures of the hip model (Figure 23a). The loading speed was set at 10 mm/s, and the maximum load was limited to 2300 N. Ten compression tests were conducted, and the results were plotted as load-displacement curves (Figure 23b). Based on these multiple curves, load-pad displacement testing was repeated under identical conditions. The overall deformation of the structure exhibited characteristics of elastic deformation (Gang & Caiqi, 2021). Therefore, it is inferred that the saddle can safely withstand a weight of approximately 230 kg, demonstrating sufficient strength for everyday use.

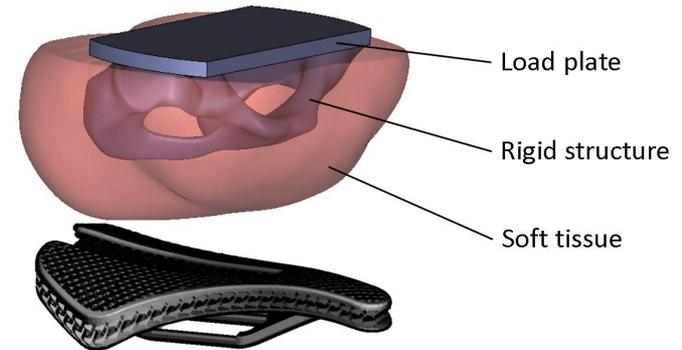


Fig. 22. Design of the hip model

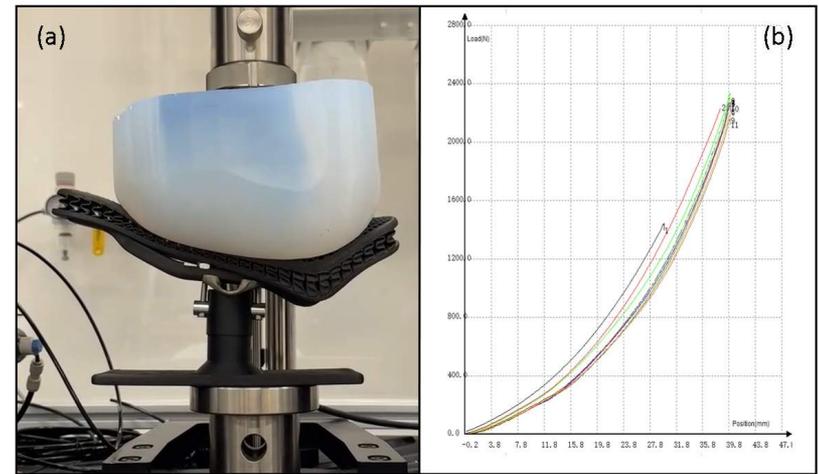


Fig. 23 Compression testing set-up (a) and results (b)

Research Outcomes, Findings & Further Research

Trial Test for Product Durability

The 3D-printed bicycle saddle was installed on various types of bicycles, including road bikes, mountain bikes, folding bikes, and mini-bikes. An experienced rider (height: 173 cm; weight: 60 kg) conducted multiple trial rides over a period of approximately nine months, covering a total distance of more than 1500 km.

The longest single ride spanned approximately 100 km, from West Kowloon to the northwest New Territories of Hong Kong (Figure 24). No visible damage or structural failure was observed after the trial period. These results suggest that the 3D-printed saddle is both durable and practical for real-world cycling use. In future studies, more subjects with different body weights, cycling habits, etc. will be recruited to gather comprehensive feedback to evaluate saddle's performances.



Fig. 24. Trial rides record

Research Outcomes, Findings & Further Research

The saddle had the following limitations that should be addressed in future research:

1. **Surface finishing:** The surface of the bike saddle was made of Onyx. After the removal of supporting materials, some edges remained rough. Future work should investigate finishing techniques to eliminate these defects and ensure a smooth Onyx surface. This would reduce friction between the saddle cover and the rider, thereby improving comfort.
2. **Colour and material options:** Most bike saddles on the market are black, highlighting the need for a wider range of colours to suit personal preferences. Achieving colour variations can be challenging with certain 3D-printed materials. Therefore, alternative 3D printing materials should be explored to allow flexible colour and material choices, enabling the saddles to meet customer expectations regarding aesthetics and overall bike appearance.
3. **Comprehensive trial rides and comfort evaluation:** While compression testing was conducted in this study, end-user feedback is critical for refining the product design. A primary goal of this saddle was to alleviate common rider discomfort. Due to time and funding constraints, only one person participated in trial rides with the 3D-printed saddle. Although this individual used the saddle for over three months and provided positive feedback, this data is not sufficiently comprehensive to fully assess the saddle's quality or guide further design improvements. Future studies should involve a larger group of participants for trial rides. In-depth interviews and questionnaire surveys should be employed to collect both qualitative and quantitative data on saddle performance.

Research Dissemination

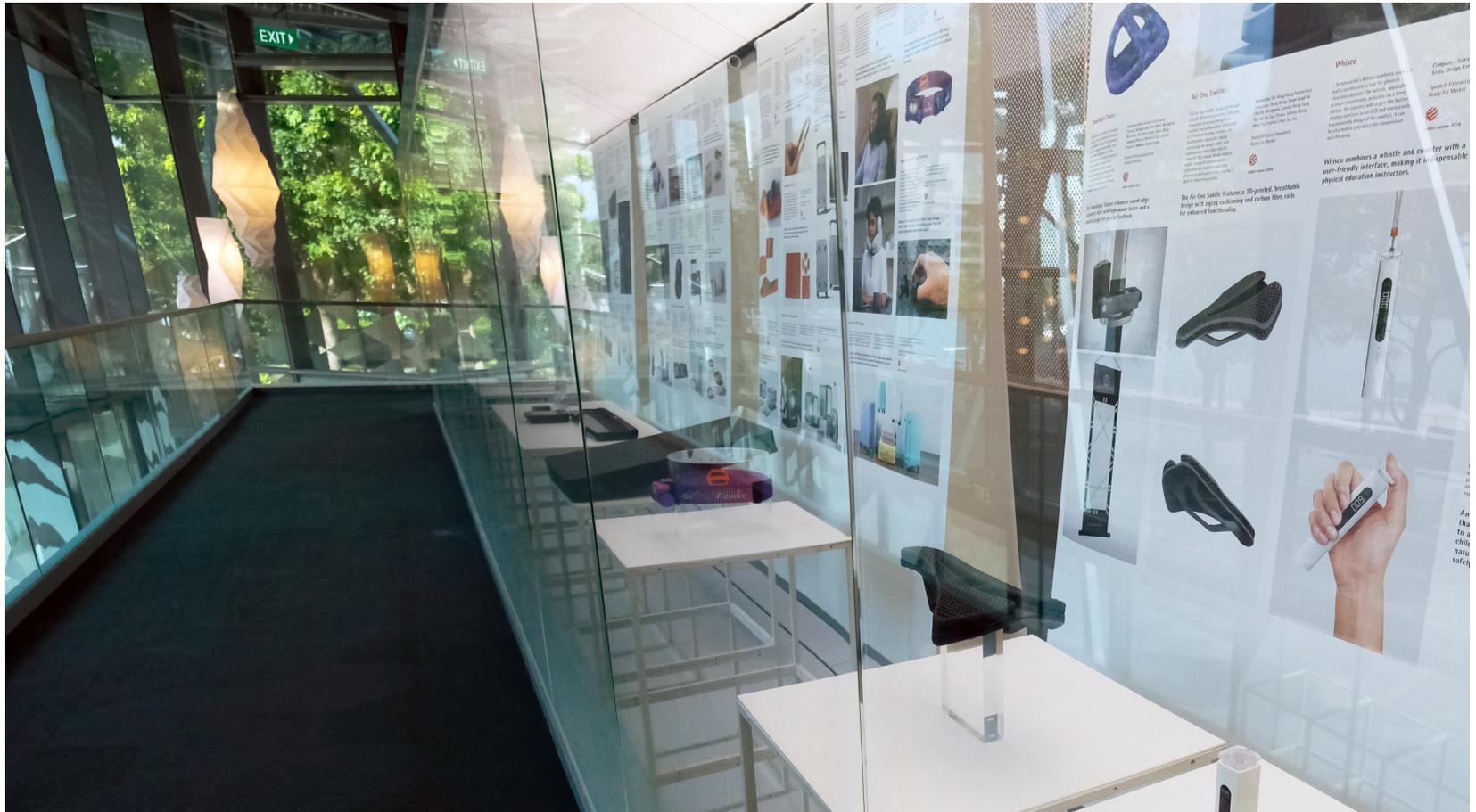
1. Red Dot Design Award 2024 – Design Concept
2. Exhibition - Red Dot Design Museum (Singapore)
3. Red Dot Design Concept Year Book 2024/2025 (ISBN978-3-907671-06-1)
4. Red Dot Online Exhibition (<https://www.red-dot.org/project/air-one-saddle-72150>)
5. SFT Activewear Design (<https://www.aded-sft.com/news/air-one-saddle-wins-red-dot-design-award-for-design-concept/>)
6. China Patent
7. Hong Kong Short-Term Patent
8. Hong Kong Registration of Design

Research Dissemination



Winner Award: Red Dot Design Concept 2024

Research Dissemination



Exhibition: Red Dot Museum (Singapore)
Period: Oct 2024 – Oct 2025

Image Credit: Red Dot Award: Design Concept

Research Dissemination



Red Dot Design Concept Yearbook 2024/2025

Air One Saddle

Sports & Fitness Equipment
Ready For Market

University

The Hong Kong Polytechnic University,
Hong Kong

Team Lead

Ho Chu Po

Designers

Tommy Hong Tung Ho, Joe Au Sau Chuen,
Sidney Wong Wing Fai, Frankie Chan Siu Fai

Red Dot

The Air One Saddle features a 3D-printed, breathable design with zigzag cushioning and carbon fibre rails for enhanced functionality.

The Air One Saddle, produced through a single 3D printing process, integrates innovative structural designs for comfort and performance. It features a 3D-knitted looping structure for breathability, adjustable zigzag cushioning for weight relief, and continuous carbon fibre rails for strength. This unique design reduces saddle sores and accommodates customisation based on individual physiological characteristics, making it ideal for discerning cyclists.

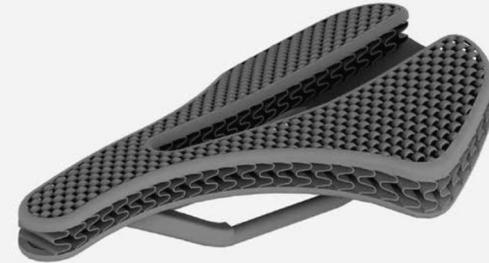
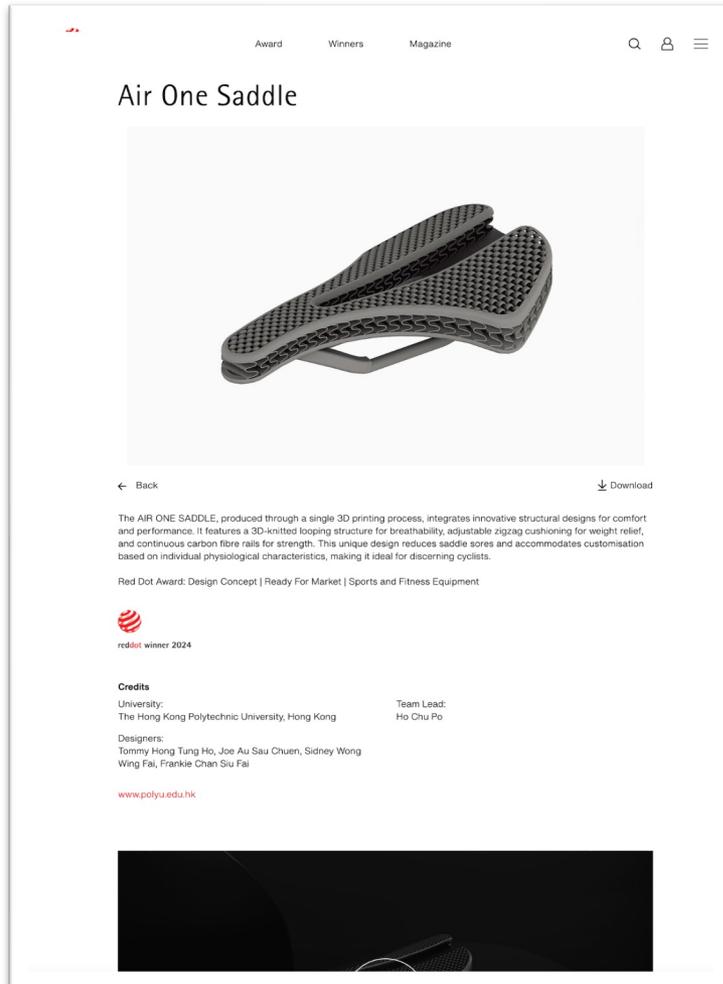


Image Credit: Red Dot Award: Design Concept

Research Dissemination



Red Dot Design Award Webpage (Online display)
<https://www.red-dot.org/project/air-one-saddle-72150>

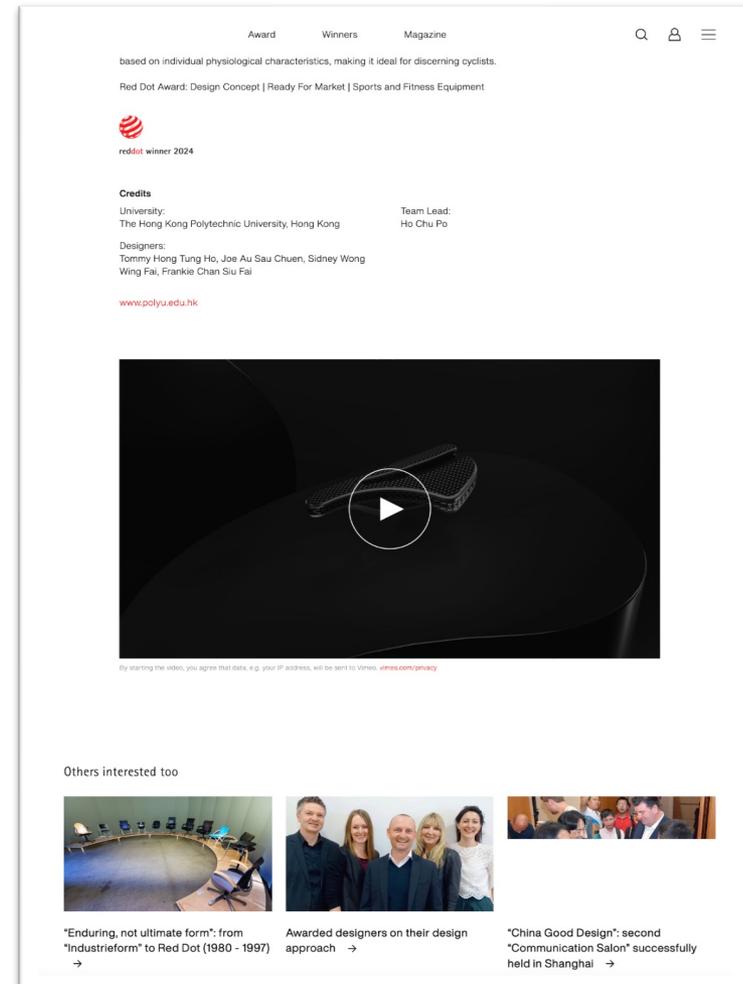


Image Credit: Red Dot Award: Design Concept

Research Dissemination

Product animation used on the following websites:

- Red Dot Design Award webpage and Instagram
- SFT Activewear Design webpage

The animation effectively highlights both the aesthetic and functional attributes of the saddle, including its potential for air and water penetration, shock absorption, and stylistic considerations. Titled "Air One Saddle", the animation's logo design emphasizes key design elements, such as the "rails design" and the inner structure of the zigzag padding layer. The animation's primary objective is to showcase the innovative and technological aspects of the saddle and attract potential collaborators for future partnerships.



<https://www.red-dot.org/project/air-one-saddle-72150>

Research Dissemination

The screenshot shows a website for 'ACTIVWEAR DESIGN' at THE HONG KONG POLYTECHNIC UNIVERSITY. The navigation menu includes 'About us', 'Members', 'Projects', 'Publications', 'Patents', 'News', and 'Contact Us'. The main content area features a news article titled 'AIR ONE SADDLE Wins Red Dot Design Award For Design Concept' dated 'Award 2024.10.10'. The article includes a video thumbnail showing a 3D-printed saddle and a certificate, and a text block describing the award and the saddle's features. A 'Related Patents' section is also visible at the bottom of the article.

ACTIVWEAR DESIGN
THE HONG KONG POLYTECHNIC UNIVERSITY
School of Fashion and Textiles Research

About us Members Projects Publications Patents **News** Contact Us

Home — News — AIR ONE SADDLE Wins Red Dot Design Award for Design Concept

AIR ONE SADDLE Wins Red Dot Design Award For Design Concept

Award 2024.10.10

The image shows a 3D-printed saddle and a certificate. The certificate is titled 'Certificate of Award' and 'AIR ONE SADDLE'. It features a red and white striped ribbon graphic. The saddle is shown in a close-up view, highlighting its intricate 3D-printed structure.

The Activewear Design Team has claimed the prestigious Design Concept – Red Dot Design Award with their innovative AIR ONE SADDLE. This cutting-edge bike saddle introduces groundbreaking features that redefine cycling performance and comfort.

Crafted through a single 3D printing process, the AIR ONE SADDLE showcases a streamlined production approach that combines precision and durability. Its 3D-knitted looping structure ensures superior breathability, keeping riders cool during long journeys. The adjustable zigzag cushioning provides targeted weight relief, reducing pressure points and enhancing overall comfort. Additionally, the continuous carbon fibre rails deliver exceptional strength while maintaining a lightweight design crucial for optimal performance.

What makes the AIR ONE SADDLE truly unique is its customization capability. Designed to adapt to individual physiological characteristics, it minimizes saddle sores and ensures a tailored fit for each cyclist, addressing common discomforts associated with long rides.

The recognition at the Red Dot Design Award celebrates the Activewear Design Team's forward-thinking approach, placing the AIR ONE SADDLE among the most innovative advancements in cycling gear today.

Related Patents

2024

一种基于三维打印的鞍座及自行车
by Ho C.E., Hong T.H., Au S.C., Wong W.F., Chan S.F.

The video thumbnail shows a 3D-printed saddle on a bicycle seat post. The saddle is black with a complex, knitted structure. The background is a blurred purple and blue light effect. The video player interface includes a play button, a title 'Air One Saddle', and a 'YouTube' logo.

Media coverage – SFT Activewear Design

<https://www.aded-sft.com/project/three-dimensional-printed-bike-saddle/>

Research Dissemination

Patent – China (File Date: 10 May 2024) (English translated by “Google Translate”)

Application number or
patent number:
202410381359.1

Document serial number:
202405050700674580

Applicant or patentee: PolyU

Invention title: A saddle and bicycle based on three-dimensional printing

Notification of preliminary examination of invention patent application

 国家知识产权局	
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申请号或专利号: 202410381359.1	发文序号: 2024050700674580
申请人或专利权人: 香港理工大学	
发明创造名称: 一种基于三维打印的鞍座及自行车	
发明专利申请初步审查合格通知书	
上述专利申请, 经初步审查, 符合专利法实施细则第50条的规定。 根据专利法第34条的规定, 专利申请自申请日起满十八个月即行公布。 初步审查合格的上述发明专利申请是以: 2024年3月29日提交的说明书摘要 2024年3月29日提交的权利要求书 2024年3月29日提交的说明书 2024年3月29日提交的说明书附图 为基础的。	
提示: 1. 发明专利申请人可以自申请日起3年内提交实质审查请求书、缴纳实质审查费, 申请人期满未提交实质审查请求书或者期满未缴纳或未缴足实质审查费的, 该申请被视为撤回。 2. 专利费用可以通过网上缴费、银行/邮局汇款、直接向代办处或国家知识产权局专利局缴纳, 缴费时应当写明正确的申请号/专利号、费用名称及金额, 未提供上述信息的视为未办理缴费手续。了解缴费更多详细信息及办理缴费业务, 请登录国家知识产权局官方网站。	
审查员: 马建斌 联系电话: 010-62084492	审查部: 
210304 条件申请 国威诺奇: 110888 北京前海新区黄厂桥西北侧路6号 国家知识产权局专利局受理处收 2023.03 电子申请: 应当通过专利业务办理系统以电子文件形式提交相关文件, 除另有规定外, 以纸件等其他形式提交的文件视为未提交。	

The above-mentioned patent application, after preliminary examination, complies with the provisions of Article 50 of the Implementing Rules of the Patent Law. According to Article 34 of the Patent Law, a patent application shall be published eighteen months from the filing date. The above-mentioned invention patent applications that pass preliminary examination are: Summary of instructions filed March 29, 2024 Claim filed March 29, 2024 Prospectus filed March 29, 2024 Instructions and Figures Submitted on March 29, 2024 based.

hint: 1. An applicant for an invention patent may submit a request for substantive examination and pay the substantive examination fee within 3 years from the date of application. If the applicant fails to submit a request for substantive examination or fails to pay or fails to pay the substantive examination fee in full within the time limit, the application will be deemed to be withdrawn. 2. Patent fees can be paid online, bank/post office remittance, or directly to the agency or the Patent Office of the State Intellectual Property Office. The correct application number/patent number, fee name and itemized amount should be stated when paying. Failure to provide the above information will be deemed as failure to complete the payment procedures. For more detailed information on payment and to handle payment services, please log on to the official website of the State Intellectual Property Office.

知識產權署專利註冊處
Patents Registry
Intellectual Property Department



香港特別行政區政府
The Government of the Hong Kong
Special Administrative Region

批予短期專利證明書

《專利條例》(第 514 章)

CERTIFICATE OF GRANT OF SHORT-TERM PATENT

Patents Ordinance (Chapter 514)

茲證明下述短期專利在今日批予:

I hereby certify that a short-term patent with the following particulars has been granted today:

專利編號 Patent No.: HK30103452

申請編號 Application No.: 32024089450.3

專利所有人姓名或名稱及地址 Name and Address of Proprietor:

香港理工大学

THE HONG KONG POLYTECHNIC UNIVERSITY

香港

九龙红磡育才道 11 号

發明名稱 Title of Invention:

一種基於三維打印的鞍座及自行車

3D PRINTED BIKE SADDLE AND BICYCLE WITH A 3D PRINTED BIKE SADDLE

短期專利有效期(在符合續期的規定下) Term of Short-term Patent (subject to renewal):

由 29.03.2024 起計 8 年

Eight years commencing on 29.03.2024

專利編號 Patent No. HK30103452

日期: 2024 年 06 月 28 日

Date: 28 June, 2024

專利註冊處處長黃福來

David F.L. Wong

Registrar of Patents

註: 1. 短期專利的有效期最長為 8 年, 由專利申請的提交日期起計。專利所有人須遵照《專利條例》及《專利(一般)規則》的規定, 繳付訂明的續期費, 維持專利有效。繳付續期費時, 須一併遞交清晰的專利續期表格。
The term of a short-term patent is up to a maximum of 8 years from the date of filing of the patent application. The proprietor shall pay the prescribed renewal fees in accordance with the Patents Ordinance and the Patents (General) Rules to keep the patent in force. Fees should be accompanied by the specified patent renewal form.

《專利條例》第 126(2)條規定, 如欲在短期專利的申請的提交日期起計的第 4 年屆滿後將短期專利再維持有效 4 年, 須在該第 4 年的屆滿前 3 個月內繳付續期費。凡批予專利日期是在自該專利的申請的提交日期起計的第 4 年屆滿之後, 則根據《專利條例》第 126(3)條, 續期費須在批予日期起計的 3 個月內繳付。
Under section 126(2) of the Patents Ordinance, to keep the short-term patent in force for a further 4 years after the expiry of the 4th year from the date of filing of the application for the patent, the renewal fee shall be paid within the 3 months ending with the expiry of the 4th year. Where the date of grant of the patent occurs after the expiry of the 4th year from the date of filing of the application, the payment of renewal fee shall be made within 3 months from the date of grant in accordance with section 126(3) of the Patents Ordinance.

如專利註冊處在上述期限內沒有收到有關表格及續期費, 則在期限屆滿後 6 個月內繳付的續期費, 必須連同訂明的逾期附加費一併繳交。如專利註冊處未能在訂明期限內收到有關費用, 專利便會停止有效。
If the form and fee are not lodged with the Patents Registry within the above-mentioned period, any renewal fee paid within the period of 6 months after the end of that expiry shall be accompanied by the prescribed additional fee for late payment. If no fee is received within the prescribed period, the patent will cease to have effect.

有關短期專利續期日期的詳情, 請利用知識產權署的網上檢索系統(<https://esearch.ipd.gov.hk>)查詢。
For the particulars of the renewal due date of the short-term patent, please use the Intellectual Property Department Online Search System (<http://esearch.ipd.gov.hk/>) for inspection.

2. 本專利的擁有權如有改變, 或所有人的姓名/名稱及/或地址/送達地址改變, 必須立刻向專利註冊處處長申請更改註冊。
Upon any change of ownership of this patent, or change of name and/or address/address for service of the proprietor, application should AT ONCE be made to the Registrar of Patents to register the change.

3. 專利註冊處處長在批予短期專利前並無就發明的可享專利性進行實質審查。請參閱香港特別行政區知識產權署網站的“短期專利”一節(<https://www.ipd.gov.hk/en/patents/patent-basics/index.html>)內的進一步資料。
The grant of a short-term patent does not follow a substantive examination of its patentability by the Registrar of Patents. For further information, please refer to the section “Short-term patents” of the website of Intellectual Property Department Hong Kong SAR (<https://www.ipd.gov.hk/en/patents/patent-basics/index.html>).

知識產權署外觀設計註冊處
Designs Registry
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香港特別行政區政府
The Government of the Hong Kong
Special Administrative Region

外觀設計註冊證明書
《註冊外觀設計條例》(第 522 章)
CERTIFICATE OF REGISTRATION OF DESIGN
Registered Designs Ordinance (Chapter 522)

茲證明下述外觀設計之詳情於今日記入註冊紀錄冊。

I hereby certify that the design with the following particulars has been entered in the register today:

- [11] 註冊編號 Registration No.: 2423061.3
- [15] 註冊日期 Date of Registration: 2024 年 03 月 29 日
- [51] 洛迦諾分類號 Locarno Classification No.: Cl. 12-11
- [54] 物品 Article (s):
自行車鞍座 Bicycle saddle
- [55] 外觀設計的表述 Representation of the Design:
見後附表述 See attached representation(s)
- [57] 新穎性陳述 Statement of Novelty:
表述所顯示的物品的式樣、裝飾、形狀、構形是聲稱具有新穎性的外觀設計特色。
The features of the design for which novelty is claimed are the pattern, ornament, shape, configuration of the article as shown in the representations.
- [73] 註冊擁有人姓名/名稱及地址 Name and Address of Registered Owner:
香港理工大学 THE HONG KONG POLYTECHNIC UNIVERSITY
香港
九龍紅磡育才道 11 号

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註冊編號 Registration No. 2423061.3

日期: 2024 年 07 月 19 日
Date: 19 July, 2024

外觀設計註冊處處長黃福來
David F.L. Wong
Registrar of Designs

- 註: 1. 外觀設計的註冊, 由註冊當日開始生效, 而註冊日期則可追溯至註冊申請的提交日期。除聯繫或相應外觀設計外, 外觀設計的註冊的首屆有效期為自註冊申請的提交日期起計的 5 年, 註冊有效期可每次再延長 5 年, 但總共不得超過自註冊申請的提交日期起計的 25 年。
- Note: 1. Registration of a design takes effect from the Date of Registration, which is backdated to the filing date of the application for registration. Except for associated or corresponding designs, the initial period of registration of a design is 5 years beginning on the filing date of the application for registration. The period of registration may be extended for additional periods of 5 years each but the total period of registration may not exceed 25 years beginning on the filing date of the application for registration.
2. 本外觀設計的擁有權如有改變, 或擁有人姓名/名稱及/或地址/遞送地址改變, 必須立刻向外觀設計註冊處處長申請更改註冊。
- Upon any change of ownership of this design, or change of name and/or address/access for service of the registered owner, applicant should AT ONCE be made to the Registrar of Designs to register the change.
3. 外觀設計註冊處處長在註冊外觀設計前並無就外觀設計的可享註冊性進行實質審查。詳情請參閱香港特別行政區知識產權署網站的“申請程序”一節(<https://www.ipd.gov.hk/en/designs/apply-for-a-registered-design/application-process/index.html>)。The Registrar of Designs has not conducted substantive examination of the registrability of the design prior to its registration. For further information, please refer to the section "Application process" on the website of Intellectual Property Department of the Hong Kong SAR (<https://www.ipd.gov.hk/en/designs/apply-for-a-registered-design/application-process/index.html>).

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