Modular Course C: Design Engineering

Unit C 1– Digital Desing and engineering Tools

LC1.3 - Engineering testing and evaluation methods

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DISHOLEA | Improving the digital skills of workforce in Shoe and Leather goods Industry in Jordan and Palestine | GA 101129194

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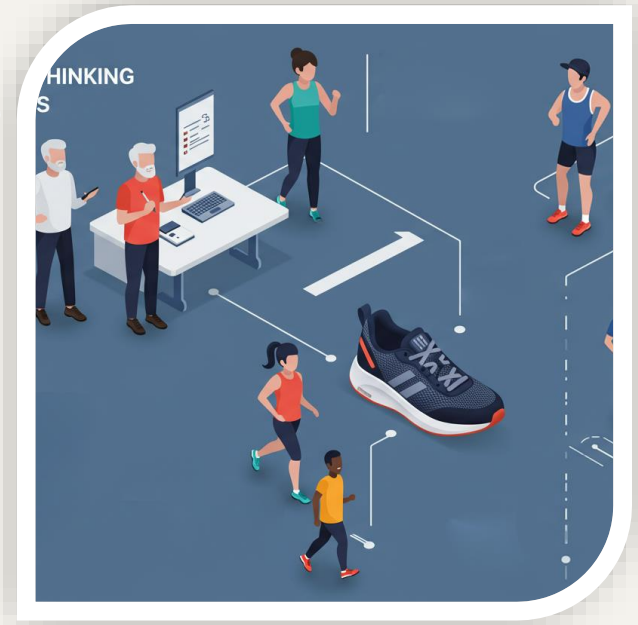

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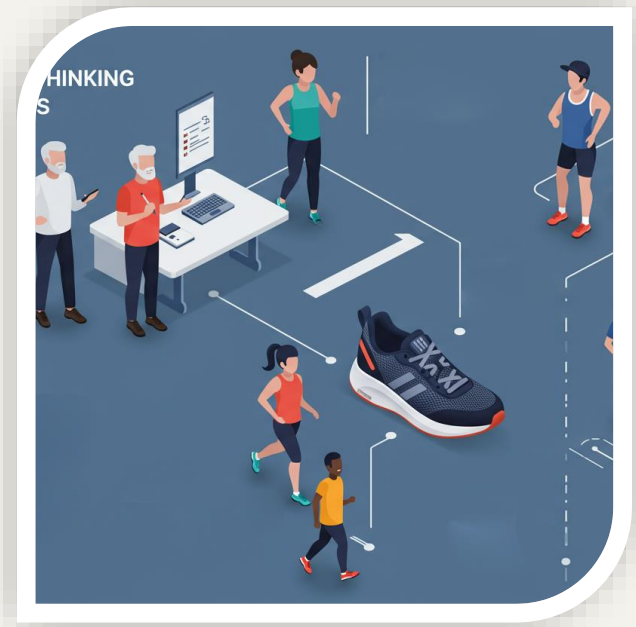
Various testing and evaluation methods are employed to ensure the quality and performance of footwear and leather products. These tests cover a wide range from the mechanical strength of materials to the behavior of the finished shoe in use.



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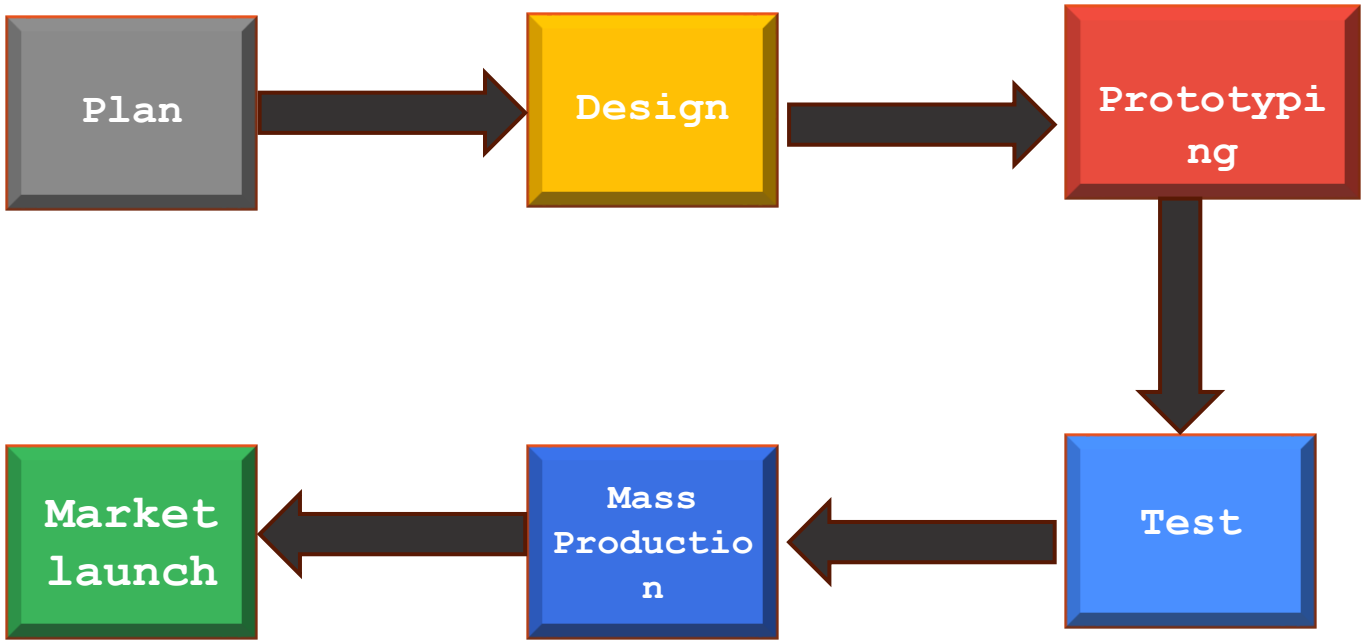

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Objectives of Tests

- Predicting the lifetime of the product
- Identifying potential user risks
- Certifying compliance with standards
- Supporting the quality control system in the production process.

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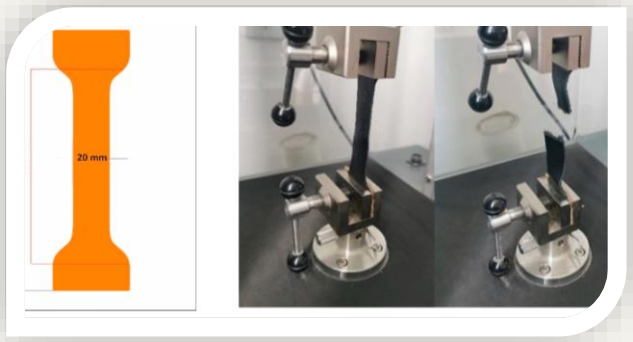
Types of Tests

Physical and Mechanical Testing

1) Tensile Test: Measures the strength of leather and textile upper materials.

2) Tear Strength: Determines the resistance to puncture or rupture.



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Types of Tests

Physical and Mechanical Testing

Bending/Flex Test: It is used to measure the flexural and bending properties of a material.

Friction and Abrasion Test: It determines how the material reacts to friction under a given pressure and its wear resistance.

Heel Impact Test: It is done to determine the risk of breakage in heeled shoes.

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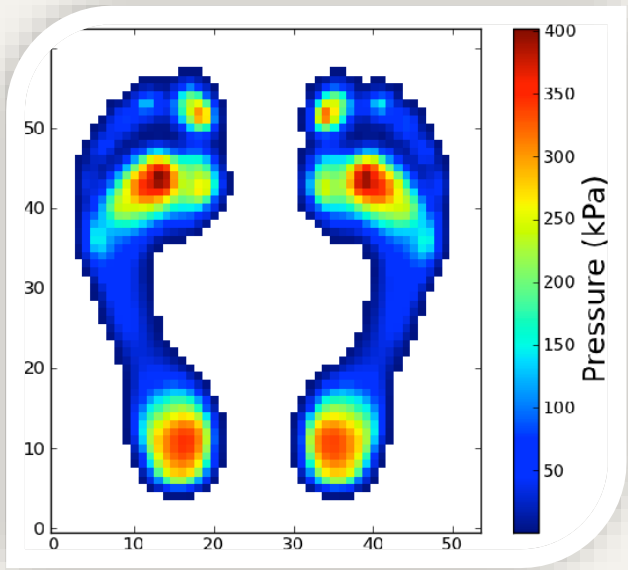
Types of Tests

Comfort and Ergonomics Tests

In-shoe Pressure Mapping: Sensor-based systems are used to measure the load distribution at the sole of the foot.

Temperature and Humidity Measurement: The effect of long-term use on the sweating and temperature balance of the foot is examined.

Biomechanical Tests: During the gait cycle, the foot-sole interaction is analyzed.



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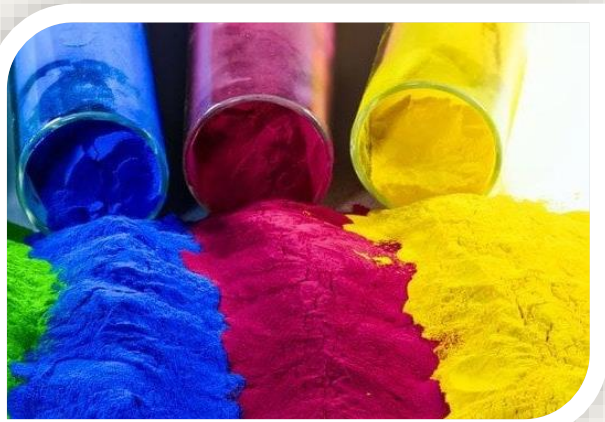
Types of Tests

Chemical Tests

Harmful substance analyzes are performed on leather and textile materials:

- Such as Chromium VI, Azo dyestuffs, Formaldehyde, Phthalate tests.
- These tests are imperative for eco-friendly production and consumer health.



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Types of Tests

Environmental Testing

It determines the durability of shoes to external conditions.

Water Penetration: It's a process that measures how water-resistant the shoe is.

Temperature/Humidity Cycling Test: The heat expansion or shrinkage of materials is evaluated.

UV Resistance Test: When exposed to sunlight, discoloration or surface degradation is examined.

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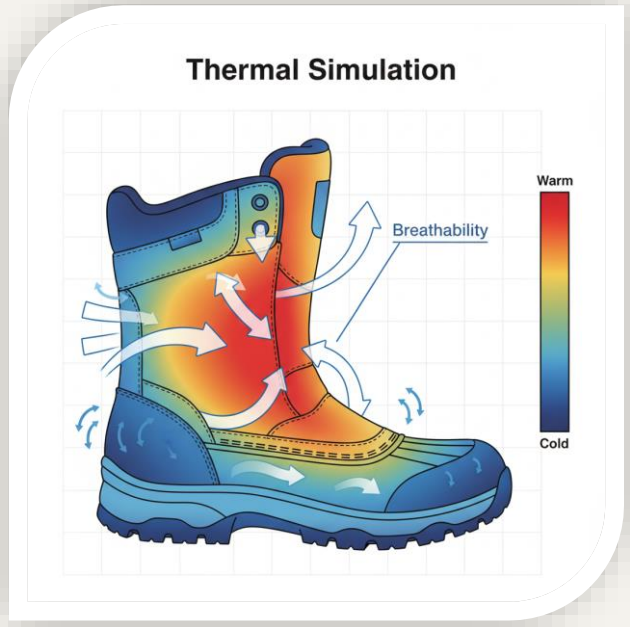
Types of Tests

Digital and Simulation-Based Tests

With the effect of digitalization, testing processes are also transforming. **CAE and CAD** integration enables physical testing to be digitized



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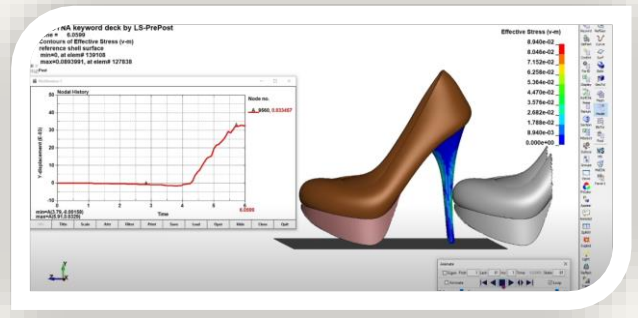
Types of Tests

Digital and Simulation-Based Tests

- It allows for bending, impact, and deformation analysis on virtual prototypes.
- It reduces the number of physical tests.
- Shortens product development time.
- It saves energy and materials.



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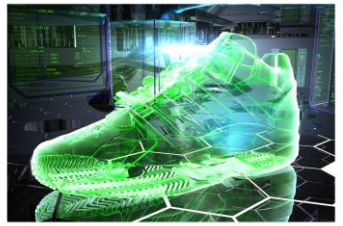
Types of Tests

Digital and Simulation-Based Tests

For example, modeling the base geometry in a CAD environment and virtually testing the flexural strength using the FEA method makes it possible to perform design validation without the need for physical testing.



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Physical vs. Digital Testing

Cost	High (material + time)	Low (virtual)
Duration	Days/weeks	Minutes/hours
Repeatability	Limited	High
Sustainability	There may be material waste	No materials are used

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Industry 5.0 and Smart Test Systems

- Instant quality assessment with smart sensors and data analytics
- Artificial intelligence learning test systems
- Human-centered and data-based "proactive quality engineering"
- Real-time testing → real-time design optimization

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Future Perspective

Artificial intelligence and big data analytics have started to automate testing processes. Smart test systems can perform instant analysis with data from sensors and evaluate product performance in real time. Thus, the era of "proactive quality engineering" began instead of "reactive quality control".