With the Same Yarn and Density, the Order of Crossings Alone Spreads Interlacing Fourfold, the Mean Float Being Its Reciprocal

— the mean float times the interlacing density is exactly **1** in every weave, and plain weave and **8**-end satin differ in interlacing by **4.000000** — the separator is whether a fabric's character is set by the yarn or by the order of crossings — [Paper 740]

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— *From thinking to syncing.* —

Abstract

A woven fabric made from the same yarn at the same count still changes in hand and sheen with the way the threads cross.What the way of crossing determines is counted from the repeating pattern.No new theorem or law is claimed. First, interlacing density is set by the weave alone——from 1.000000 in plain weave to 0.250000 in 8-end satin (Section 2). **Second, the span is fourfold——4.000000 between plain and 8-end satin, and 2.500000 with 5-end satin** (Section 2). **Third, and this is the core. The mean float is exactly the reciprocal of the interlacing density——the product is 1.000000 in every weave, so "long floats" and "few interlacings" are two readings of one quantity** (Section 2). **Fourth, yet one number does not say it all——2/2 and 3/1 twill share density 0.500000 and mean float 2.000000, with longest floats of 2 and 3** (Section 3). **Fifth, the share of yarn on the face moves separately——0.500000 and 0.750000 for the same two twills, and 0.125000 for 8-end satin** (Section 3). **Sixth, the separator is whether a fabric's character is set by the yarn or by the order of crossings——with yarn and density fixed, order alone moves three quantities** (Section 4). **Keywords**: weave structure, plain weave, satin weave, interlacing density, float, share of yarn on the face.

Scope of this paper (scope note): **No new theorem or law is claimed——plain, twill and satin weaves, and the notions of float and interlacing, are all known (Peirce 1937, Hearle, Grosberg and Backer 1969).Mechanics are not derived——drape, strength, yarn slippage and tearing are not treated; only the repeating pattern is counted.Yarn geometry is not included——crimp, thickness and twist are not included.No real fabric is claimed——brands and standards are not treated.Sheen is not quantified——the link between the share on the face and lustre is mentioned only.Relation to earlier papers**: **Paper 342 showed that mixing the same two materials in the same proportion can spread stiffness by 16.93——there a continuous freedom, fibre direction, spread the property. Here a discrete freedom, the order of crossings, does. The freedom of direction, and the freedom of order.**What is added is **counting interlacing density and float for each weave**, **showing their product to be exactly 1**, **showing a fourfold spread between plain and satin**, **showing pairs that share density but differ in longest float and face share**, and **placing the separator on yarn against order of crossings**.

1. Notation and the Question

Setting: **at each crossing write 1 if the warp is on the face and 0 if it is behind. A weave is a repeating pattern of these 0s and 1s.**

$$\text{interlacing density} = \frac{\text{number of face changes}}{\text{number of crossings}}, \qquad \text{mean float} = \frac{\text{total length of same-face runs}}{\text{number of runs}}$$

Counts are taken along both warp and weft, with the repeat treated as cyclic.

Question: **with yarn and density the same, what does the way of crossing change?**

2. Interlacing Density and Float Are One Quantity

Computation 2.1: **for six weaves, interlacing density, mean float, longest float and share of warp on the face were counted.**

weave	interlacing density	mean float	longest float	warp on face
plain	1.000000	1.000000	1	0.500000
2/1 twill	0.666667	1.500000	2	0.666667
2/2 twill	0.500000	2.000000	2	0.500000
3/1 twill	0.500000	2.000000	3	0.750000
5-end satin	0.400000	2.500000	4	0.200000
8-end satin	0.250000	4.000000	7	0.125000

Observation 2.2

interlacing density spreads fourfold.4.000000 between plain and 8-end satin, 2.500000 with 5-end satin——not one yarn or count has changed.

Observation 2.3

this is the core: the mean float is exactly the reciprocal of the interlacing density.In all six weaves the product is 1.000000——the total run length equals the repeat length and the number of runs equals the number of changes, so the two are faces of one quantity.

Observation 2.4

a satin has exactly one face point in each row and column, never adjacent.So an n-end satin has density $2/n$: 0.400000 at 5 and 0.250000 at 8——satin is the arrangement that interlaces least.

3. Same Density, Different Fabric

Observation 3.1

2/2 and 3/1 twill share density and mean float.Both are 0.500000 and 2.000000——yet their longest floats are 2 and 3.

Observation 3.2

the share of yarn on the face differs too.0.500000 for 2/2 and 0.750000 for 3/1, whose face leans to warp ——in 8-end satin only 0.125000 of the face is warp.

Observation 3.3

so the way of crossing is not captured by one number.Interlacing density (equivalently mean float), longest float and face share move separately——they are said to bear on firmness, snagging and appearance respectively, but this paper does not derive those mechanics.

4. The Separator

Observation 4.1

the separator is whether a fabric's character is set by the yarn or by the order of crossings.With yarn and density fixed, order alone moves three quantities——"same yarn, same count" does not yet determine the cloth.

Observation 4.2

beside Paper 342.Paper 342 showed that mixing the same two materials in the same proportion spreads stiffness by 16.93——there a continuous freedom, direction, did it. Here a discrete one, order, does. Direction and order.

Observation 4.3

what is not said.Mechanics, yarn geometry, real fabrics and sheen are not treated; only the repeating pattern is counted——what is shown is the quantities the order of crossings sets, and how they relate.

5. Roll Call and Closing

1. **plain 1.000000** (Computation 2.1): **most interlacing.**
2. **8-end satin 0.250000** (Computation 2.1): **least.**
3. **a spread of 4.000000** (Observation 2.2): **same yarn.**
4. **2.500000 with 5-end satin** (Observation 2.2): **in between.**
5. **float times density $= 1.000000$** (Observation 2.3): **the core.**
6. **8-end satin float 4.000000** (Computation 2.1): **the reciprocal.**
7. **two twills at 0.500000** (Observation 3.1): **the same.**
8. **longest floats 2 and 3** (Observation 3.1): **different.**
9. **warp on face 0.750000 and 0.125000** (Observation 3.2): **moving separately.**
10. **yarn or order of crossings** (Observation 4.1): **the separator; Paper 342.**

Closing: **With the same yarn at the same density, the order of crossings alone spreads interlacing fourfold, and the mean float is exactly its reciprocal.Interlacing density is 1.000000 for plain, 0.666667 for $2/1$ twill, 0.500000 for $2/2$ and $3/1$ twill, 0.400000 for 5-end satin and 0.250000 for 8-end satin, a spread of 4.000000——with not one yarn or count changed.The mean float runs from 1.000000 to 4.000000, and its product with the interlacing density is exactly 1.000000 in every weave——total run length equals the repeat and the number of runs equals the number of changes, so “long floats” and “few interlacings” are two readings of one quantity.Yet one number does not say it all ——$2/2$ and $3/1$ twill share density 0.500000 and mean float 2.000000, while their longest floats are 2 and 3 and their warp-on-face shares 0.500000 and 0.750000.The separator is whether a fabric’s character is set by the yarn or by the order of crossings.Placed among the earlier papers——Paper 342 treated the continuous freedom of direction; this treats the discrete freedom of order.To be honest——mechanics, yarn geometry and real fabrics are not treated; only the repeating pattern is counted.**

References

1. Hearle, J. W. S., Grosberg, P., & Backer, S. (1969). *Structural Mechanics of Fibers, Yarns, and Fabrics*. Wiley-Interscience.

2. Peirce, F. T. (1937). The geometry of cloth structure. *Journal of the Textile Institute*.

3. Yamagishi, Y. (2026). *Mix the Same Two Materials in the Same Proportion and the Stiffness Differs by* **16.93** [Paper 342]. Zenodo. 10.5281/zenodo.22682160

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