NUMERICAL PROBLEMS IN DESCRIPTIVE GEOMETRY; FOR CLASS AND DRAWING ROOM PRACTICE

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NUMERICAL PROBLEMS

IN

DESCRIPTIVE GEOMETRY

FOR

CLASS AND DRAWING ROOM PRACTISE

REVISED EDITION

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CLASSIFICATION OF LINES AND SURFACES

- **Lines**
  - Right lines
  - Plane curves (circle, ellipse, parabola, hyperbola, spirals, roulettes, etc).
  - Space curves (helix, spherical epicycloid, loxodrome, etc.)
- **Surfaces**
  - **Generated by Right Lines**
    - **Planes**
    - **Single Curved Surfaces** (developable)
      - All positions of generatrix parallel (cylinders)
      - All positions of generatrix intersect in common pt. (cones)
      - Consecutive positions of generatrix intersect two and two; no three positions intersecting in common pt. May be generated by a system of tangents to a line of double curvature (helical convolute.)
    - **Warped Surfaces**
      No two consecutive positions of generatrix in same plane; hence, non-developable.
      - Plane directer and two linear directrices.
        - Two rt. lines (hyper. parab.)
        - One rt. line and one curve (conoid)
        - Two curves (cylindroid)
      - Three linear directrices
        - Three rt. lines (hyperboloid of one nappe)
        - One curve, two rt. lines
        - Two curves, one rt. line (corne de vache)
        - Three curves
      - Curves generated by a rt. line touching a space curve and another rt. line, and making a constant angle with a fixed plane (helicoid)
  - **Double Curved Surfaces**
    - **Surfaces of Revolution** (sphere, ellipsoid of rev., torus, parab. of rev., etc.)
    - **Surfaces** of double curvature not generated by a revolving line nor by a rt. line. (ellipsoid).

ABBREVIATIONS

alt. = altitude.
bet. = between.
const. = construct.
cyl. = cylinder.
dia. = diameter.
dist. = distance or distant.
proj. = projection.
pt. = point.
rt. = right.
tang. = tangent.
G. L. = ground line.
H = horizontal or horizontal plane.
P = profile or profile plane.
V = vertical or vertical plane.
$\perp$ = perpendicular.
$\parallel$ = parallel.
$\angle$ = angle.
$\angle^s$ = angles.

ELEMENTARY PROPOSITIONS

1. The distance of a point from the H plane is the distance of its V projection from the ground line. The distance of a point from the V plane is the distance of its H projection from the ground line.

2. If any two projections of a point are given, the point is fully determined, and the third projection may be found from the above principle.

3. If a line is parallel to either plane of projection, its projection upon the other plane of projection is parallel to the ground line.

4. If a line is parallel to either plane of projection, it will be projected upon that plane in its true length.

5. If two intersecting lines are each parallel to the same plane of projection, the angle between the lines will be projected upon that plane in its true magnitude.

6. If a point lies in a given line, its projections will lie in the corresponding projections of the line.

7. If two lines are parallel in space, their corresponding projections are parallel.

8. The H and V traces of a plane always intersect the ground line at the same point.

9. If any two traces of a plane are given, the plane is fully determined.

10. If a plane is parallel to the ground line, its traces are parallel to the ground line, and conversely.

11. If a plane is perpendicular to either plane of projection, its trace upon the other plane is perpendicular to the ground line, and conversely.

12. If a line lies in a given plane, its H piercing point lies in the H trace of the plane, and its V piercing point lies in the V trace of the plane.

13. If a line is perpendicular to a plane, its projections will be perpendicular to the corresponding traces of the plane, and conversely.

14. If a line lies in a plane and is parallel to H (or V), its H (V) projection is parallel to the H (V) trace of the plane, and its V (H) projection is parallel to the ground line.

15. If two planes are parallel in space, their corresponding traces will be parallel, and conversely.

16. If a point in space be rotated about a line either lying in or parallel to H, the H projection of the point will always lie in the same perpendicular to the H projection of the line.

17. If a point in space be revolved into H about a line lying in H, its position in H will be at a distance from the axis equal to the hypotenuse of a right triangle whose legs are respectively the distance from the H projection of the point to the H projection of the line, and the distance from the V projection of the point to the ground line.

18. If a line not parallel to H be revolved about an axis intersecting it and parallel to H, into a position where both are parallel to H, any point in the revolved line will be horizontally projected at a distance from the H projection of the axis equal to the hypotenuse of a right triangle whose base is the distance of the H projection of the point (before revolution) from the H projection of the axis, and whose altitude is the distance of the V projection of the point (before revolution) from the V projection of the axis.

PROPOSITIONS RELATING TO WARPED SURFACES

1. The rectilinear elements of an hyperbolic paraboloid divide the directrices proportionally, and *conversely*.

2. If two right lines be divided into any number of proportional parts, the right lines joining the correspond-

ing points of division will line in a system of parallel planes, and hence be elements of an hyperbolic paraboloid, the plane directer of which is parallel to any two of these lines.

3. If any two rectilinear elements of an hyperbolic paraboloid be taken as directrices, with a plane directer parallel to the first directrices, and a surface be thus generated, it will be identical with the first surface.

4. Thru any point of an hyperbolic paraboloid, two rectilinear elements can always be drawn.

5. If two warped surfaces having two directrices have a common plane directer, a common rectilinear element and two common tangent planes, the points of contact being on the common element, they will be tangent all along this element.

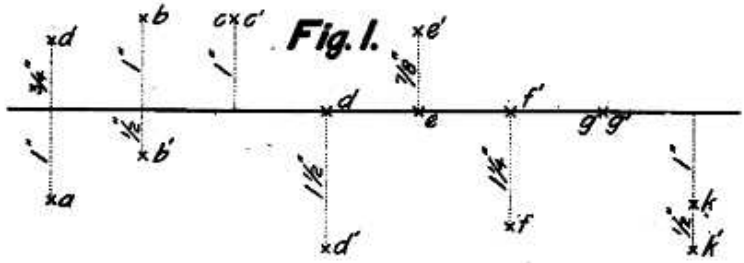
6. If two warped surfaces have an element in common and are tangent to each other at three points of the same, they are tangent along the entire element.

REPRESENTATION OF POINTS, LINES AND PLANES

1. Show the projs. of the following points properly lettered and with distances given.

The pt. A, 1″ behind V, 1½″ below H.
The pt. B, lying in V, 1″ below H.
The pt. C, 3″ in front of V, 1″ above H.
The pt. D, 1″ behind V, lying in H.
The pt. E, 2″ behind V, 1½″ below H.
The pt. F, 1″ in front of V, 1″ below H.
The pt. G, lying in V, 2″ above H.
The pt. J, 1″ in front of V, lying in H.
The pt. K, lying in V, lying in H.
The pt. L, in 3rd quadrant, 1″ from H, 2″ from V.
The pt. M, in 2nd quadrant, 3″ from H, 2″ from V.
The pt. N, in 1st quadrant, 1½″ from H, 3½″ from V.
The pt. P, in 4th quadrant, 4″ from H, 1″ from V.

2. State in what quadrant each of the points shown in the figure are located, and whether the point is nearer H or V.



3. Show the projs. of the lines

AB, || to H, || to V, in 3rd quadrant.

CD, || to H, perpendicular to V, in 2nd qaudrant.

EF, || to H, inclined to V, in 1st quadrant.

GH, inclined to H, || to V, in 1st quadrant.

JK, ⊥ to H, parallel to V, in 2nd quadrant.

MN, inclined to H, inclined to V, in 1st quadrant.

OP, inclined to both planes of proj. and in a plane perpendicular to the G. L., in 1st quadrant.

QR, inclined to V, and lying in H. beyond G. L.

ST, inclined to H, and lying in V above G. L.

UV, lying in both H and V.

4. Const. the projs. of two lines, AB and AC, intersecting in A, one || to H, the other || to V.

5. Show the projs. of a line joining a point A in the 2nd quadrant with a point B in the 3rd quadrant.

6. Show the projs. of a line joining a point C in the 4th quadrant with a point D in the 1st quadrant.