

ENGINEERING RESEARCH INSTITUTE  
UNIVERSITY OF MICHIGAN  
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QUARTERLY PROGRESS REPORT NO. 8  
HINGE POINTS OF THE HUMAN BODY

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This eighth quarterly report consists of monthly reports of work which cover October, November, and December of 1953. Under the heading "ANNOTATIONS" additional comments are presented.

REPORT ON WORK DURING OCTOBER

Project work during October involved approximately 300 hours of time by research assistants in addition to contributions by the principal investigator. The major activities of the month were as follows:

1. Data on the second half of our sample on the hand kinetosphere problem were processed. An error in data processing for the earlier records necessitated a rechecking. Another week and a half at the present rate, however, should see all these data in shape for writing up.
2. Data gathering and the processing of records continued on the effect of body dead weight on push and pull forces by the hand.
3. A series of computations was made on the relation of body circumferences to section areas. This work will contribute to determinations of regional distribution of mass for living subjects.
4. Certain phases of the research have been written up.

November should see completion of the hand and foot kinetosphere work as well as completion of the work on joints. Writing up of the study will continue.

REPORT ON WORK DURING NOVEMBER

Project work during November involved 505 hours of time by research assistants and by the typist in addition to work by Dr. Gaughran and the principal investigator. Major activities were as follows:

1. Writing and illustration of aspects of the final report proceeded. Some seventy continuous pages of first draft plus other notations on special phases of the work have now been completed.
2. Analysis of work on the hand and foot kinetospheres was completed and is ready for writing up.
3. Some work on the analysis of instantaneous centers of the major limb joints continued.
4. The summary of measurements and statistics relating to joint range was completed and a start on similar data describing the study sample was made.
5. Body circumference and cross-sectional areas of subjects were correlated for the different body types studied and computations and graphs were completed.
6. Additional work involving multiple repetition added to the data on body dead weight in relation to push and pull forces.

During December the primary activity will be a continuing of data processing and the writing up of the material.

REPORT ON WORK DURING DECEMBER

During December, project work required 550 hours of time by research assistants and an illustrator plus 96 hours of secretarial work. The principal investigator and his collaborator also contributed. Major activities were as follows:

1. Work on joint centers based on cadaver material has been virtually completed.
2. Gathering and processing of data on the effect of body dead weight on horizontal push and pull forces continued.

3. Work relating to the location of upper limb joint centers for the seated subject based on frame-by-frame analysis of motion-picture records of test movements proceeded.
4. Work continued on the preparation of illustrations and on the writing of the final report.

The next month's work will include (1) more work on writing of the final report, (2) additional work on dead weight vs horizontal work forces, (3) data gathering on push and pull force vectors in relation to regions of the work space envelope, and (4) some work on the planning of a design mannikin.

#### ANNOTATIONS

During the last quarter of 1953, the principal emphasis of the research effort has been directed to the consolidation and writing up of work done. Cross-checking of records for consistency and statistical computations have become increasingly important activities. Processing of data has been virtually completed in some areas such as those relating to hand and foot kinetospheres, and only the written presentation of the data and the preparation of illustrations remain. Since the writing falls primarily on the principal investigator, it necessarily cannot be a continuous activity. During the following months of the research, this type of activity will have increasing importance.

Data processing relating to joint centers, both on cadaver joints and on seated test subjects, formed one of the chief activities in the consolidating of data already at hand.

The completion of work on joint centers and on the locations of shoulder and hip joint centers for the seated subject will provide a necessary background for the design of a profile mannikin. As soon as these data are available in usable form, further work on osteological material and on anthropometric measurements will be needed to acquire the remaining data necessary for the designing of a mannikin.

Active data gathering for the quarter has been restricted almost entirely to work on cadaver joints and to work on the relation of body dead weight to horizontal push and pull forces. A new setup designed to check and evaluate sagittal push and pull force vectors for the various regions within the work space is now ready for operation. Work with a small study sample of subjects will continue for the next few months.

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All in all, the project work at the present time is clearly in a terminal phase. There is every prospect that the contract objectives will be met in every respect.

