# NEWSLETTER NUMBER 1

## JANUARY 1976

## FORCE PLATFORM GROUP

## INTERNATIONAL SOCIETY OF BIOMECHANICS

Group Chairperson

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(The Newsletter is circulated free to members of the Force Platform Group. Membership enquiries to the secretary).

Contents

## Chairperson's Message

University Park, Pa.
U.S.A.

December, 1975.

Dear Colleague:

The newsletter that you are now reading represents the first in a biannual series which has been financed through your contribution to the Force Platform Group of the ISB. As you will see from the contents of this first issue, we hope to include news, bibliographic information, original and reprinted articles, all of which should aid the force platform user in making a greater contribution to the study of human motion through the measurement of force.

As with any group, our strength and longevity will be a function of the input from the individual members. I would urge you to help in two ways: Firstly, please let the editor of the newsletter have any ideas that you might generate concerning material to be included in future editions. The newsletter is a far stronger means of communication than one meeting of the Group every two years, and in such a small group we shall need input from almost every member. Secondly, if you are aware of force platform users who are not members of our group, please encourage them to get in touch with us so that we can benefit from their input.

It is my hope that at the next International Congress of the ISB in 1977, one of the program sessions will be specifically devoted to a scientific (rather than organizational!) meeting of the Force Platform Group. This should be an ideal occasion when we can begin to exchange experiences on our studies over the past two years and hopefully demonstrate the value of the Force Platform Group.

In closing, I would like to thank, on your behalf, the members of the committee who have been responsible for getting this issue of the newsletter together.

Best wishes for your work in 1976.

Sincerely,

Peter R. Cavanagh, Ph.D.
Chairperson
Force Platform Group
ISB.

## Editorial

At the 1975 Fifth International Congress of Biomechanics in Jyväskylä, Finland, a meeting was held by the Force Platform Group of the International Society of Biomechanics.

Peter Cavanagh was elected Chairperson and the editor was elected Secretary of the Group. At that meeting there was much discussion about the usefulness, or otherwise, of our Group - a controversy which may be an interesting subject for a "letter to the editor" section in later issues(!) - but it was decided, as a first step, to establish a regular newsletter. As Peter Cavanagh pointed out in his first letter in August 1975 to potential members, the biannual newsletter should be initiated with the following objectives:

a. To provide a bibliographic service to group members on a regular basis.

b. To publish original articles on topics related to force measurement in human biomechanics.

c. To provide a forum for questions and answers on related subjects.

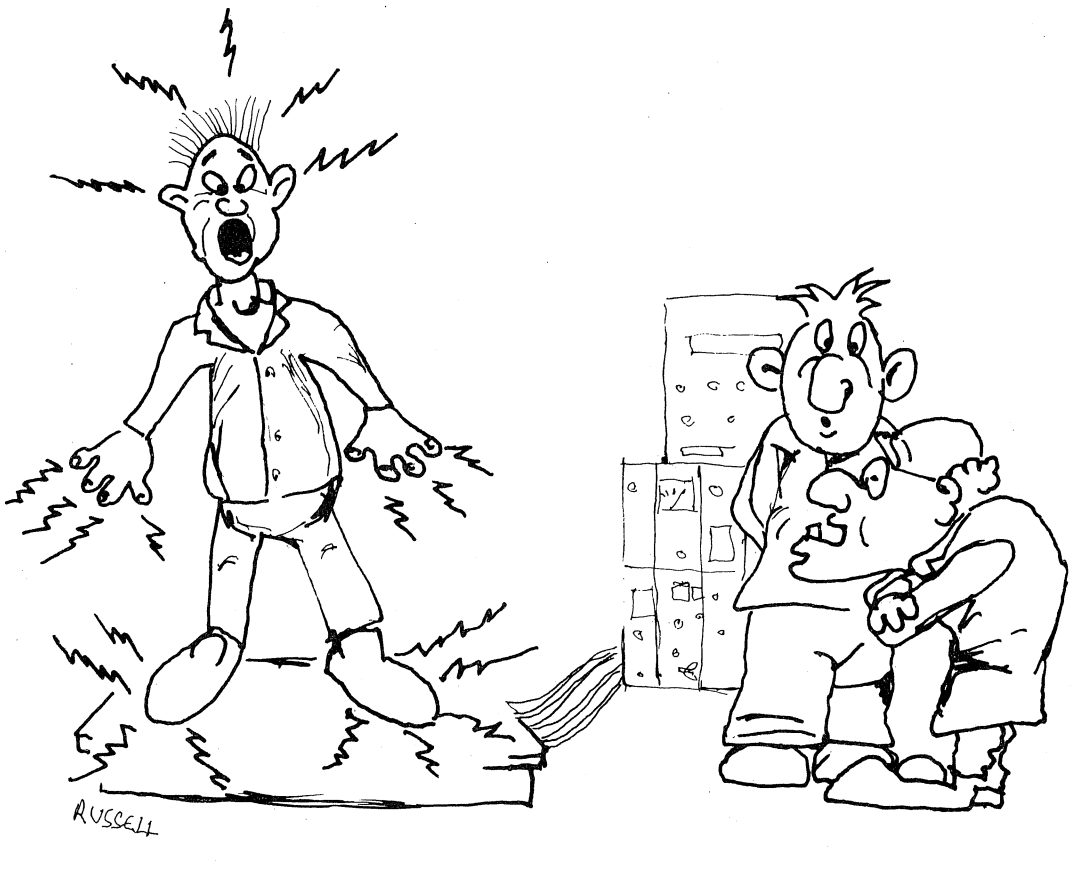
To ensure the continuity of the newsletter and of the group, it was decided to charge an annual subscription of $ US 5-00 per subscriber (institution or individual). This fee will be used to offset costs and it was decided by the group to circulate the newsletter and future copies of the catalogue only to paid-up members.

In this first issue we are grateful to our contributors Jim Hay and Barry Wilson for their excellent bibliography, which I am sure is going to form the basis of, or add considerably to, our personal collections. You are urged to cross check this bibliography with your own and send anything, which could be added, to Barry Wilson, whose address appears with the bibliography.

We are also grateful to Gustav Gautschi for his article on installation of force platforms, written in his delightful humorous fashion, reminding us all of the enjoyment to be had from our work with force platforms (when we aren't having earthing problems, or the like, that is!)

Several members have written in with contributions and these will be appearing in the Newsletter Number 2 in July 1976, together with an up-to-date list of members and their addresses.

Objective c "To provide a forum for questions and answers" has not been achieved in this newsletter, since no questions have been received. If you have any problems in your own work, and you wish to know how other researchers deal with them, please write to the editor.




"Hmmm.... We must have mixed up those wires again."

## Force Platforms on Shaky Ground

by Gustav Gautschi.

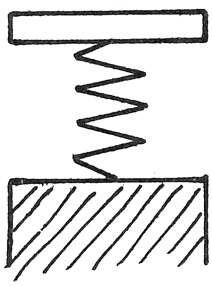
Condemn the fault, and not the actor of it.

Measure for Measure.

For good results, force platforms ought to be installed always on solid ground - it is as simple as that!

Unfortunately the choice of available locations does not always include one of solid ground. What are the problems encountered on what we might then call shaky ground?

A force platform typically consists of a base plate and a top plate between which usually 4 force transducers are sandwiched. As long as the base plate is mounted on solid ground, the system will essentially behave like a simple mass spring system as shown in figure 1.



Evidently there will be no output from the transducers as long as no force is acting on the top plate, and that obviously is what we want!

If the ground on which the platform is mounted is not at rest but vibrates, we will have an output from the transducers even though no external force is acting on the platform. Why?

The platform acts now like an accelerometer and the top plate takes the role of the so-called "seismic mass". The top plate which has a finite mass m is forced to follow the movements of the base plate and the force transducers register these forces. The output from the platform is thus a direct measure for the vibrations of the ground and it would be even possible to calibrate the system to measure these vibrations.

As the natural frequency of a well-designed force platform is of several hundred Hertz, building vibrations which are usually below 50 Hz do not excite the platform resonance.

What we have called so far "shaky ground" usually turns out to be a shaky floor in some building.

There are two basic types of problems with shaky floors:

1. The floor as such is rigid, however the building is shaking.
2. The building as such is rigid, but the floor is too elastic (springy).

The third possibility we had rather better not even look at:

A combination of problem 1. and 2.!

Problems of type 1. occur mainly in modern high rise buildings, which rely on a steel skeleton as the basic supporting structure. Floors themselves are usually quite rigid (or at least they can be made rigid).

In such buildings, vibrations are plenty: elevators, air-conditioners, people walking, machinery of all sorts, wind etc. are some of the possible sources. These vibrations are virtually always in the 0 ... 50 Hz range, i.e. in exactly the same range as most biomechanical phenomena are!

A force platform located in such a building will therefore simply show the building vibrations, also when no external force is acting on the top plate.

Three remedies are possible:

a) Placing the platform on a large mass (at least about 1 ton!), which is embedded in a vibration absorbing material of suitable elastic and damping properties.
b) Introducing accelerometric compensation.
c) Install the platform on solid non-shaking ground.

Remedy a) obviously is not very practicable and most likely impossible to be realized (a mass of even 1 ton may not be sufficient by far...).

Remedy b) appears easy at first: an accelerometer measures separately the vibrations of the floor. The signal from the accelerometer is then simply combined with the signal from the unloaded platform in such a way (phase, amplitude and polarity) that they cancel each other out. With a simple platform that measures only the vertical force component such a compensation may be quite feasible.

Most platforms however measure all 3 components of the force - and thus also the building vibrations in all 3 components!

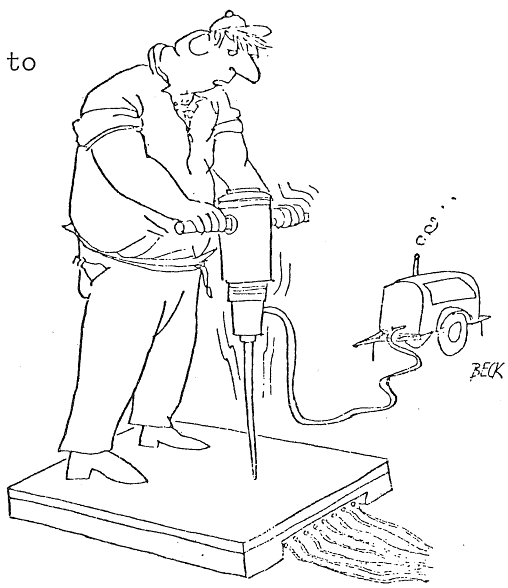
Moreover a typical platform has a top plate mounted on usually 4 transducers. The top plate of course has 6 degrees of freedom, 3 axes of translatory vibrations and 3 axes of rotational vibrations. Needless to say that the complexity of accelerometric compensation quickly reaches the point of not only being financially insupportable but simply technically impossible.

Referring to the type 2. of shaky floors, the springy type,one can flatly state that it is useless even to consider using a force platform on it. A floor which yields noticeably under the forces exerted on the platform falsifies the result. Such a floor will also be readily set in oscillation when just walking or running towards the platform, thus adding the problem type 1.

In summary the answer to whether one should place a platform in a high rise building or on a springy floor simply is: <u>Don't!</u>

When selecting the location for the platform, always try to get on the ground floor. If there is a basement beneath, make sure the floor is of very rigid construction (thick concrete slab, short span etc.). Often old buildings offer better conditions, but beware of floors supported by wooden beams or light I-beams. To be sure, make preliminary tests by placing the platform in the proposed location. Set the amplifiers to the most sensitive range you will have to use in your work (not the most sensitive range possible on the amplifiers!) Walk around the floor, stomp hard on it, jump etc. and observe the output signals from the platform. This experiment will tell you something about the "springiness" of the floor. Then also observe the output signal from the platform with no load on it and nobody walking around in the room. This will tell you something about the vibrations in the building as a whole. In such a way, you can get an idea of the magnitude of the unwanted signals you may have to expect. When judging building vibrations, be sure to measure at different times of the day so as not to miss for example a machine producing vibrations but running only intermittently. If you are forced to work in a room with building vibrations present, you sometimes can get around it by either working night shifts or over weekends, when other activities in the building are greatly reduced.

Again it is strongly recommended to get the platform installed on a solid, non-vibrating floor. It may even be preferable to abandon a room with a nice view on the floor of a high rise building and get installed in a simple barrack in the back-yard, where you can put the foundation for your platform directly into the ground!



And when you get funny signals, remember not to blame the platform: the vibrations you are measuring may not be the vibrations you think you are measuring!

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CH 8053 Zurich,
Switzerland.


"But Professor, his union says he must have his tea break".

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by James G. Hay
and Barry Wilson.

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Additions to the above bibliography will be gratefully accepted by Barry Wilson. It is hoped that these will then be published from time to time in the Newsletter.

## Correspondence Received

Jim Hay of the University of Iowa, U.S.A., has sent details of his group's re-designed platform.

Briefly:- Top plate. 30" x 30" x ¾" Aluminium machined honeycomb.

Transducers. Strain gauged proving rings.

A full account will be given in the next issue of the Catalogue.

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Klaus Nicol of Der Johann Wolfgang Goethe Universität, West Germany has written two articles, which it is hoped, will be published in another Newsletter or Catalogue.

1. "Use of the Kistler Force Platform". This deals with the author's experiences in using a Kistler platform.

2. "A measuring system with multiple applicability for values in exterior biomechanics". Dr. Nicol describes a force measuring device dependent upon changes in capacitance when the dielectric is compressed.

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P.J. Perkins of the Shoe and Allied Trades Research Association in Britain has an article in his trade journal on the use of the Kistler platform for measuring forces between shoe and ground.

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John M. Cooper of Indiana University, U.S.A., reports that electronic elements of his group's force platforms are housed in an external box which means that repairs and fault finding are simplified. Details will appear in the next Catalogue.

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Per Tveit of Norges Idrettshøgskole, Norway, has used force platforms in the study of sports movements and has also used semi-conductor transducers in skates, skis and rowing swivels.

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Howard Lamb of St. Francis Xavier University, Canada, has written a review of force platform technology and use, as part of his work while studying with Peter Stothart at The University of Western Ontario, Canada.

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Thomas M. McLaughlin of the University of Illinois, U.S.A. is working on a platform which uses flex plates and a load cell devised by Dr. C. Bowman of the same university.

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Reg. J. Whitney of the Medical Research Council Biomechanics Research Team in Britain has transferred his force platform to Farnborough and is using it for postural sway and centre of gravity studies.

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John L. Hagy of Shriners Hospital for Crippled Children in San Francisco, U.S.A. has led a team in the design and use of a plexiglass-topped force plate, 24" x 24". The platform uses piezoelectric quartz crystal load cells manufactured by Kistler Instrument Company. John Hagy has helped several other hospitals and clinics in the U.S.A. in the construction of similar force platforms. Details to appear in a later Newsletter.

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Benno M. Nigg of the Eidg. Technische Hochschule in Zurich, Switzerland has sent an extensive list of publications which report on his work with two Kistler platforms and P.A. Neukomm's "Impulsmessgerät" which is a device for integration of the force time function. Details in a later Newsletter.

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Gordon W. Judge of Biomechanical Research Unit of the Department of Health and Social Security, Britain is building an aluminium honeycomb plus carbon fibre topped platform using Kistler load cells. Some of the electronics will be made by Kistler and some will be made by the group's electronics section.

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Louis E. Freund of the University of Missouri - Columbia, U.S.A., reports on a force platform built and loaned to him by Western Electric. This platform is a modification of the Hearn and Konz design at Kansas State University.

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# *MINUTES OF A MEETING OF THE FORCE PLATFORM GROUP OF THE INTERNATIONAL SOCIETY OF BIOMECHANICS

Jyväskylä Finland | 6.30 p.m. 2nd July 1975

Present:

| | | | |
|---|---|---|---|
| E. Bosco | FIN | F. Brussatis | GER |
| K. Vilyamaa | FIN | H. DuPuis | GER |
| C. Putnam | USA | B. Nigg | SWI |
| D. Miller | USA | J. Cooper | USA |
| K. Fidelius | POL | G. Ariel | USA |
| J. Terauds | USA | N. deBruyn | ZAR |
| R. Claeys | BEL | M. Desipres | ZAR |
| A. Ayalon | ISR | E. Willems | BEL |
| P. Stothart | CAN | K. Nicol | GER |
| P. Francis | CAN | E. Hennig | GER |
| J. Hay | USA | L. Stoner | USA |
| W. Schröder | GER | D. Kelley | USA |
| G. Gautschi | SWI | M. Arcan | ISR |
| P. Tveit | NOR | H. Payne | GBR |
| | | P. Cavanagh | USA |

There being some uncertainty about the aims and objects of the Force Platform Group, and therefore the need for a committee, it was decided that a temporary Chairman be elected for the preliminary discussions. Howard Payne was elected.

B. Nigg questioned the need for a committee since the Group's recent Catalogue seemed to be adequate. G. Ariel said that his own work was sometimes in need of interpretation and he would welcome some kind of forum of people with similar problems.

P. Stothart suggested several alternatives for the Group's activities - a Catalogue, a newsletter and special meetings like the present one at ISB conferences.

P. Francis pointed out that one individual could not be expected to control this output. M. Desipres thought that the Group should be a body within the ISB.

P. Cavanagh said that there was a need for regular communication, with abstracts and references, and agreed with the idea of a newsletter.

P. Francis nominated J. Hay as bibliography compiler. J. Hay agreed, pointing out that the Group should be capable of work which would not be possible for any individual to carry out alone.

J. Cooper supported the idea of a newsletter and as the discussion was beginning to lead on to the details of this newsletter it was decided to elect a committee. There was some discussion about the size and content of the committee and eventually the following were elected unanimously.

| | | Proposer | Seconder |
|---|---|---|---|
| Chairman | Peter Cavanagh | H. Payne | F. Brussatis |
| Secretary/Treasurer | Howard Payne | P. Francis | D. Kelley |

The new Chairman then took the chair and asked for suggestions for the newsletter. On P. Francis' and P. Stothart's proposal it was decided to aim for 1st January 1976 as the posting date for the first newsletter.

There was much discussion about the content of the newsletter and in summary the proposals were:-

1. A review of the state of the art of force platform construction. (Action - G. Gautschi)
2. A research publications bibliography. (Action J. Hay)
3. An attempt to identify textbooks with information about instrumentation. (Action - J. Hay)
4. A section on clinical applications. (Action - F. Brussatis)
5. A question and answer section.
   (Questions should be sent to the secretary by September 1975 so that he can attempt to find the answers before the first newsletter deadline).

At this stage K. Nicol asked for a definition of a force platform and the Chairman replied that it could be any device which measures forces at the feet in biomechanics research.

Funding of the newsletter was discussed but the final decision was to be left with the committee which was to fix a membership fee.

The Chairman agreed to write a letter within the next month or so to those present and all those on the Catalogue mailing list to inform them of the discussions and decisions taken at the meeting.

The meeting closed at 7.25 p.m.

A.H. Payne
<u>Secretary</u>

*Please note that these minutes have not yet been ratified, but are reproduced here for the benefit of members who were not at the meeting.