"SDRC has something like 70 programs that are inter-related so you can do frame analysis, structural analysis, linkage analysis, and rotating machinery analysis," Mr. Barclay said. "What SDRC has done is taken such major programs as NASTRAN and ANSYS and added pre- and post-processors to make them easier to use. Because of what SDRC has done, we find it more advantageous to use their programs, especially with the level of CYBERNET support, than to continue to develop the finite element programs created at Ontario Research.

"We find that you can model a structure more easily using SDRC's SUPER, which is an interactive program that formats data for SUPERB, a finite element program. You can get a printout of what the finite element model looks like and inspect it at any time before you submit it for analysis.

"Once the analysis is complete you can request output in several different ways. Previously we just used the computer printout, which is not the easiest thing in the world to digest. Now, using the SDRC post-processors we get a graphic output so we can quickly see where the high stress concentrations and the consequent local deformations are.

"You can talk to the client about these stress areas with this graphic material. The client can be brought into the picture very quickly without having a knowledge of the finite element method."

Building Bridges

Ontario Research combined the SDRC and other structural analysis programs from CYBERNET Services with its expertise in engineering and testing to help one client evaluate a plate girder concept as used in the construction of new bridges.

In this project, the contribution of the concrete deck to the strength of the steel girder was the factor of prime interest in terms of local stresses generated at the supports. The local stress distribution in the area of the supporting piers established by this study produced reliable design parameters to be used in subsequent designs.

Ontario Rcsearch first created a model of the girder design and analyzed it mathematically with SUPERB. At the same time, a physical model of one-fifth scale was built and tested with strain gauges to confirm that the mathematical and physical models behaved the same way.

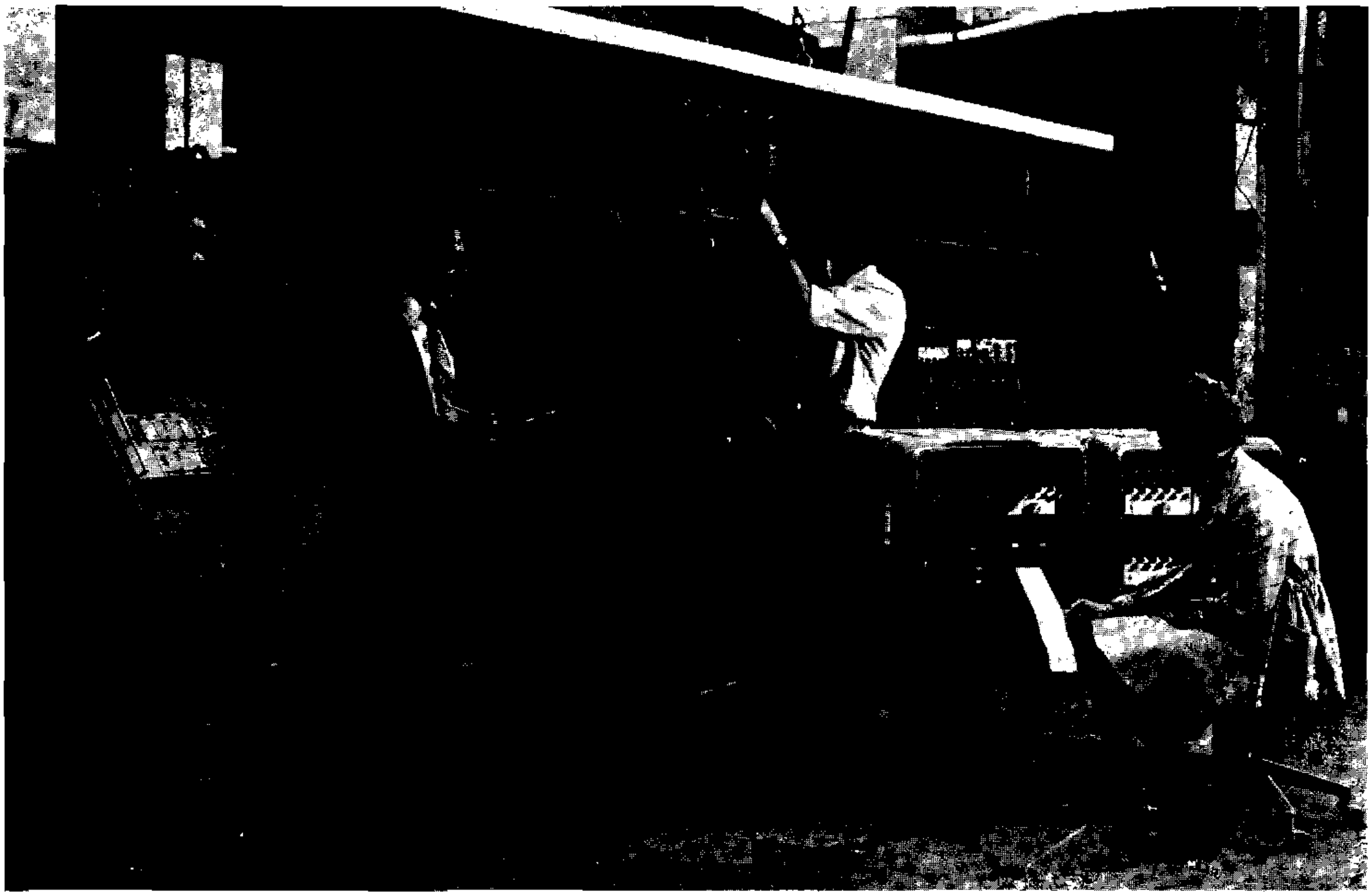
"If the correlation is good," Mr. Barclay said, "then model results can be used in full scale design. In this case correlation was within 3.5 percent, which is well within the acceptable range.

"Once a good finite element model is developed, design variations ean be readily checked out at minimum cost without further physical testing."

Accuracy is Greater

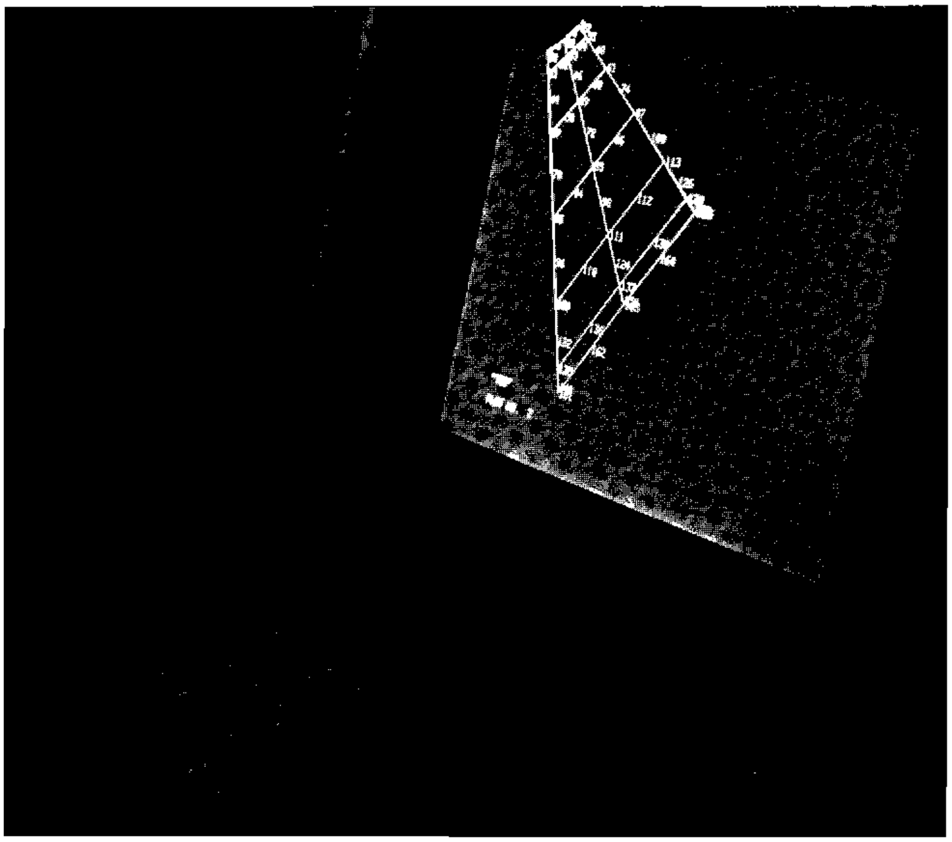
Current analytical techniques such as finite element computer programs and experimentation, provide Ontario Research clients with more accurate evaluations of loaded structures than can be achieved through hand calculations using classical formulae.

"Using classical techniques," Mr. Barclay said, "the simplification was quite major; you had to assume what would happen. It was a judgment job based on the experience of the experimenter. He would decide by feel



Strain gauge testing of the plate girder bridge concept in one-fifth size was compared with results of SUPERB analysis, a use of the SDRC technique of combining physical testing with computerized analysis.

SDRC graphics give the engineer an easily understood picture of the structural model used in finite element analysis.



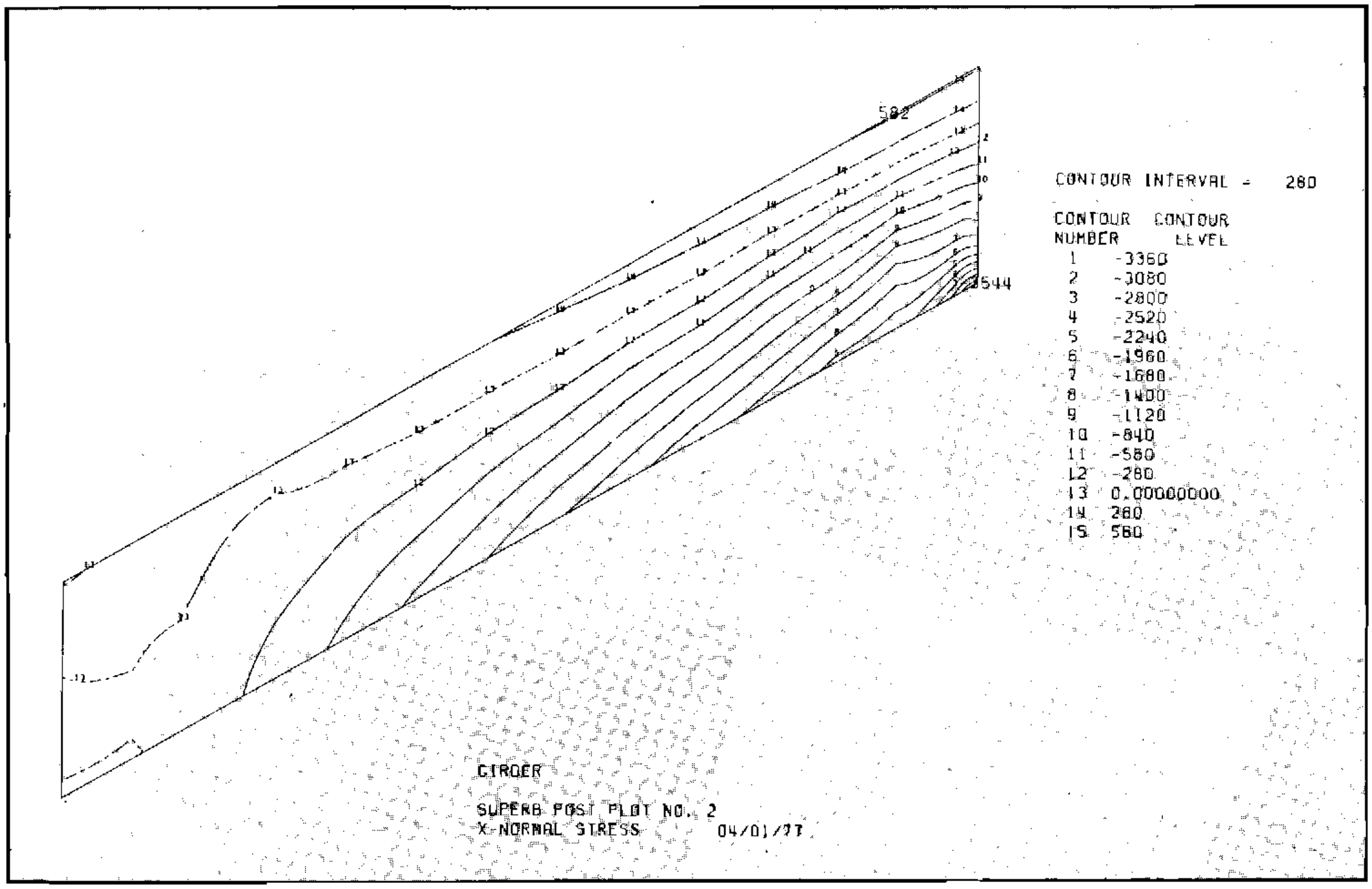
where the high stresses were and, as a result, would probably have to use far more instrumentation. Even then it would be hit and miss that he was picking up the area of high stress.

"Now you can start with a coarse grid or a macro model to decide where the high stress areas are. Then you can focus on those high stress areas with micro models and get very precise detail of the area.

"An example we are working on now is railway wheels. It is very important to pinpoint the high stress area due to centrifugal loads within an eighth of an inch. By trial and error methods that would take you an infinite amount of time. With the finite element method you can pick up the approximate high stress areas easily, then search in a small area to find the precise point of high stress."

Ontario Research Offers Service

Ontario Research uses the theme "Teamwork in Technology" to describe how it tailors its service to the needs and capabilities of its clients. In some cases, Ontario Research may undertake an entire technology consulting job in



A plot from SUPERB showed the stress contours in the girder.

which it does all design and analysis. Or, they will offer a client the assistance to do the project. Perhaps the first time in a structural or mechanical analysis project, Ontario Research will step through the job with the client using the SDRC programs from CYBERNET Services. As the client gains expertise, he can do more of the job himself.

"One of the main benefits of the SDRC programs", Mr. Barclay said, "is that the software is written in such a way that it is easy for a relatively new computer user to apply sophisticated techniques to problem solving."

Another Ontario Research offering is a walk-in service for building finite element models. A client can use a digitizing tablet and a cathode-ray-tube (CRT) terminal in the Ontario Research offices in Mississauga, a suburb of Toronto, to build a model for finite element analysis with the SDRC programs. The client puts the drawing of the structure on the digitizing tablet and moves a cursor over the drawing. Where he wants a point, he presses a button and automatically gets a joint number or node number and its coordinates. He can view his model on the CRT terminal in three-dimensional or isometric form to see that he didn't miss or mislocate any points. When he has built his model he can submit it for analysis by Ontario Research or through his own resources.

"The most time-consuming part of finite element analysis is inputting all the numbers to the computer," Mr. Barclay said. "If you automate that, as SDRC has done, then you save an awful lot of time and this is exactly what we are doing with this walk-in service."

An Ontario Research analyst demonstrates how the digitizing tablet can save time in finite element analysis when compared with hand preparation of data.

Stan Barclay, Assistant Director of Engineering: "One of the main benefits of the SDRC programs is that the software is written in such a way that it is easy for a relatively new computer user to apply sophisticated techniques to problem solving."

That service is another facet of the Ontario Research drive to bring advanced technology to Canadian industry.

"We've placed a great deal of emphasis on the SDRC techniques of integrating finite element analysis and mechanical testing, or computerized systems analysis," said F. D. M. Williams, Vice-President, Engineering. "We want to promote such worthwhile techniques to the industry at large so products are no longer produced by the old prototype method where you make 10 and bit by bit test them to destruction. By using analytical and experimental techniques, industry can develop products that make good use of ever dwindling resources, especially energy."

"Actually," Mr. Barclay said, "these techniques are not really new. They have been known for a long time. What we were lacking was the sheer computing horsepower. CYBERNET Services, for example, gives us that horsepower, and SDRC has put these techniques in a usable form. Before that they were in the domain of the professors, not the users".

For additional information about the SDRC programs, please contact your Control Data sales representative or circle No. 1 on the enclosed reader reply card.

New Elements Added to CDC/NASTRAN

New elements, multilevel substructuring methods and a labor-saving dynamic analysis feature have been added to CDC/NASTRAN structural analysis available worldwide from CYBERNET Services.

Three new isoparametric elements provide greater accuracy in analysis and improved cost effectiveness. The user can choose parameters for various element features to such an extent that the new element can replace several old classical elements.

The new QUAD4 quadilateral plate element and the new TRIA3 triangular