DBUG

DATACAD BOSTON USERS GROUP

BSA A Committee of the Boston Society of Architects

MINUTES
DataCAD Boston User Group (DBUG) Meeting on 20 September 1989

The DBUG meeting on 20 September 1989 was hosted by Ivan Bereznicki Associates and Geoff Langdon at the offices of Ivan Bereznicki in Cambridge, MA.

Three new attendees introduced themselves and identified areas in which they could use assistance from other members.

Ivan introduced the staff in his office: Jim Lynch, Michael Tardif and Marianne Charkovsky. Geoff Langdon, hosting with Ivan, was also introduced.

CADKEY Dealer Meeting by Skip Mulch
(CADVision, Merrimac, NH)

Skip first asked *"How many had received the CAD-KEY newsletter, 3D World?"* Apparently, no one had. The newsletter was mailed to all DataCAD users, and we should be receiving it soon.

The following points were addressed at the Dealer Meeting:

PLEASE NOTE THAT PRICES QUOTED BELOW ARE VALID THROUGH JANUARY 1, 1990.

- CADKEY is going to let the world know about DataCAD through an intensive advertising campaign.
- A bounty had been put out on AutoCAD: Anyone who is using AutoCAD with the AEC add-on can trade in *for up to $1,200.00* on the purchase of DataCAD.
- CADKEY has lowered the price of DataCAD from $3,500.00 to $2,795.00. The reduced price includes the DC Modeler. Maintenance for the first year, however, has been backed out and will be an additional $695.00 per year.
- DataCAD, DC Modeler and Velocity will be available as a package at a cost of $3,290.

- Purchase of DC Modeler and Velocity is available at a cost of $695.
- The cost of Velocity has been reduced from $2,000.00 to $495.00.
- DataCAD and DC Modeler can be purchased at a cost of $975. for additional workstations under a site license.
- "DataCAD 128", a new product is being introduced at a cost of $79.95 and will include the book "DataCAD for the Architect" by Carol Buehrens. This version includes the DC Modeler and limited macros. The drawing file size is limited to 128Kb and will not include AEC macro or any upgrades.
- As part of the Educational program at CADKEY, DataCAD will be provided at no cost to schools who (a) have the required hardware and (b) exhibit substantial evidence that DataCAD will be incorporated into the curriculum.
- The annual maintenance agreement will provide telephone support and a series of macros being developed at CADKEY. There will not be any guarantee of new releases of DataCAD during the term of the agreement. However, should a new release occur, it will be provided as part of the maintenance agreement. Instead of frequent new releases, it is expected that a more continuous flow of macros will be provided. One macro, of which Skip heard, is called "WinDoor": A 3D macro for inserting doors and windows into slabs. Voids will be used for the glazing, which will enable one to view inside (or outside) of a building.

Valle Blake indicated that she had had problems installing DataCAD version 3.6e Rev. 1: The installation aborted part way through due, apparently, to missing files. Mickey Frankel suggested that one should always install a new release in a separate directory on the hard disk. Following

successful installation and testing of the new release, the old release could be deleted and the new one copied (or moved) into the correct directory.

Skip was asked if the 4Mb limit on drawing files was to be removed. This, according to discussions Skip had with the technical development team at CADKEY, is a fairly easy fix and could be addressed in a future release.

With the reduction in the price of Velocity, Skip was asked about the graphics cards supported. At present, only four are supported: **Artist 10** (Control Systems, St. Paul, MN), **Verticom-H256** (Western Digital Imaging, Mountain View, CA), **Image Manager** (Vermont Microsystems, Winooski, VT), and **VGA**. While VGA is readily supported in the industry, Skip feels that the results are somewhat "cartoonish" in appearance. (This is due to the limit of 320x200 on resolution when 256 colors are used.) As a result, if one is to use Velocity for rendering, it would be better to go with the higher resolution cards. He also indicated that version 4.0 of DataCAD would include additional drivers that work with both DataCAD and Velocity. As a side note, he indicated that some drivers may be released prior to 4.0.

Skip was questioned on the "new" policy on maintenance. He indicated that those currently operating on releases of DataCAD prior to 3.6e would have to purchase an upgrade to the current release. He was not aware of the upgrade cost at time. As a separate issue, the maintenance agreement would cover technical support, macros released by CADKEY and new releases if available during the term of the agreement. With regard to costs of maintenance contracts where several workstations were covered under a site license, Skip indicated that no definitive statements had been made; but that he thought the costs would be $695.00 *per* workstation.

In response to the question on the existence of any macros other than "WinDoor", Skip indicated that he had not really seen any. Due to the busy schedule at CADKEY during the dealer meeting, he did not have time to scour around. So there may be some in the works...

With regard to DataCAD and OS/2 or UNIX, Skip indicated that no formal statement had been issued by CADKEY. It is his feeling (hope) that the two would be developed in parallel.

Other Announcements

David Pendry has fixed up the *AutoTpl* program so that it works with ".*SM3*". *AutoTpl* is a program that enables one to move template and associated symbols from one directory to another (or to/from a floppy). The paths maintained in the template file for the related symbols are adjusted accordingly. This program was originally written by John Hitch of RADIUS (Raleigh, NC). If John provides permission, the program as revised by David will be placed on the bulletin board.

Rick Gleason announced that his *TextSets* macro is now completed. Demo versions are available, but will be limited to ten uses and a maximum of five layers. The macro will be sold for $69.95.

DBUG Bulletin Board Service (BBS)

David Pendry stated that the DBUG BBS now operates at 2400 baud and enables retrievals with one command. This improves use of the BBS.

A "*modem drive*" is being sponsored by the MacIntosh User Group of the BSA. By purchasing a large number of modems at one time, the benefits will be reduced cost on an individual basis. Those who wish to organize such a group for IBM's and compatibles can contact Michael Hogan at (617) 338-0050.

Geoff Langdon indicated that there is now a DataCAD section under CADKEY on Compuserve.

A recent listing of the DBUG BBS (bulletin board service) "*goodies*" was handed out.

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CAD Magazines

Other sources of information on CAD systems are:

- WindowIn on DataCAD
- MicroCAD News
- Architecture and Engineering Systems
- Computer Graphics World (Imaging and Rendering)
- Design Systems Strategies (Management Report on Automation and Productivity)
- Architectural Record (Steven Ross' column)
- CADENCE (AutoCAD)
- Versatility (VersaCAD)

Of special interest is the September issue of Architecture magazine which features Phil Hart's work. For those interested in Velocity, the October 1989 issue of Computer Graphics World contains an article entitled "Rendering with Velocity" by Eric Teicholz and Daniel Smith.

Geoff Langdon, Architectural Consultant

Geoff Langdon hosting with Ivan Bereznicki was introduced. Geoff is an independent consultant providing the following services for architectural firms: (1) Assistance in selecting hardware and software, (2) Memory management, (3) File integration (e.g. converting drawing files from one CAD system to another through DXF), (4) 3D model development, etc. Geoff stressed that he is not a dealer, and therefore has no "vested interest".

Geoff develops the 3D model in a parallel effort with the development of the 2D drawings by staff at the firm. At times, Geoff indicated, he will use several CAD systems to develop the model. This enables him to take advantage of the unique or easier to use features of each. As an example, Geoff showed the drawing of a 3D model developed with Ivan Bereznicki Associates. In this model, MegaCADD, DataCAD and Architrion (on the MAC) were used to develop the finished product.

Geoff manages a database of hardware, software, services, etc. through "Hypercard" on a MacIntosh. He was quickly asked the question, "What's hypercard?". He responded that "hypercard" is software which maintains "intelligent" pages integrating text, graphics, sound and animation. Through hypercard, one can follow a train of thought through such pages. As such, hypercard can be used to maintain a more or less free form data base. In concluding, Geoff stated "Hypercard is an experience worth looking at." On an IBM or compatible, "Hyperpad" is closest to hypercard (on the Mac). Hyperpad, however, does not include graphics, sound or animation.

Geoff also teaches a third year design class at Wentworth Institute in Boston. He is integrating the use of DataCAD as a design tool in the class.

In preparing for the remaining agenda, Geoff identified the hardware to be be used as follows:

- ALR 20 MHz with the Omnikey 102 keyboard by Northgate. (Geoff indicated that this keyboard is an excellent investment.) Originally the Photon graphics board with 2x and 4x hardware zooms was used. This provided rapid movement in and out ("WindowIn") in a drawing; however, problems with the driver forced its abandonment.
- IBM PC (not an "XT", "AT" or "386, a real PC) which had been upgraded to a 386. The upgrade was performed using the INTEL 386 PC board, 40 Mb Plus Development hard card and two high density floppies running on the original power supply. Although the upgrade is rather elegant, Geoff warned that the resulting systems can be somewhat unreliable.
- MacIntosh using Laplink for file transfers between other systems and hypercard for the database.

Geoff handed out a suggested outline for a CAD manual.

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Ivan Bereznicki Associates

The presentation by Ivan Bereznicki Associates was oriented around use of the 3D Modeler for site design. Michael Tardiff and Ivan stated that the basis for their current use of the Modeler were the following:

(1) Two sets of keyboard macros: One for 2D and another for 3D. The macros were built upon work by Phil Hart and David Pendry. Use of the keyboard macros was based upon those recommended by Phil Hart, *KEYBDMCR.ARC*. The *"ALT+Z"* keyboard interrupt is used to switch between the two sets of keyboard macros by accessing the DCAL macro, *NEW-KYMCR.ARC*, developed by David Pendry.

By having the two sets of keyboard macros, Ivan noted, efficient use of keys is retained. In the 3D set, for example, *"ALT+R"* goes directly to rectangular slab.

NOTE: *Both KEYBDMCR.ARC and NEW-KYMCR.ARC are available on the DBUG bulletin board.*

(2) Current use of the Modeler is in an early stage and is based upon the techniques presented by Phil Hart at the seminar in Norwich, VT. The seminar was very useful in that it taught the basics of the Modeler through developing a complex model of a building during the seminar.

The first use of the 3D Modeler is on a 17,000 ft^2 town center (commercial project) in West Milford, NJ. The locale is fairly mountainous and is primarily a resort area. The client is a real estate company which is to occupy approximately 4,000 ft^2. The project is to include a significant amount of parking space and is to be designed in accordance with stringent zoning ordinances, e.g. 35' set backs.

Using the techniques presented at the seminar, the following steps were performed:

(1) A simple plan of the site was developed using 2D entities.
(2) The profiles of the buildings were drawn as simple shapes in the *Ortho* view. The profiles were drawn around the edges of the locations of the building as established in the plan.
(3) The height of the building profiles were established to represent the lengths of the buildings. (See Fig. 1.)
(4) Using the 3D Edit commands the building profiles were then rotated, copied, stretched, etc. to establish the basic parallel view shown in Fig. 2.

While the hidden line removal process did not include the valleys in the roof system, these could easily be inserted through use of 3D Lines. If 3D Lines are used in this fashion, they must be placed above the slabs (or other 3D entities). If 3D Lines are placed in the plane of the slab, the hidden line removal process will remove them. David Pendry suggested adding 1/4" to the Z-Base and Z-Height for the lines. This will place them slightly above the slabs representing the roof. The lines will then remain after hidden line removal.

For more detailed work on the model, they are drawing by hand on perspectives generated by the DC Modeler.

In summary, the staff at Ivan Bereznicki Associates have discussed whether drawing by CADD is faster than by hand. At present, they believe it is a draw. However, with the 3D Modeler doing 3D work is significantly faster than anything they could do by hand. In support of this, Michael illustrated a number of design alternatives which were completed in the course of *one* day. He felt that doing the same work by hand would have taken over a week. In addition, due to the associated cost, the number of design alternatives may not have been explored.
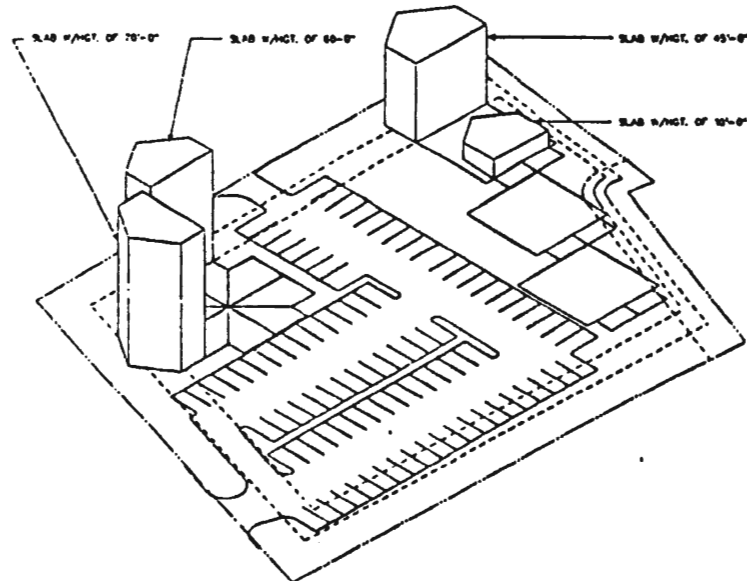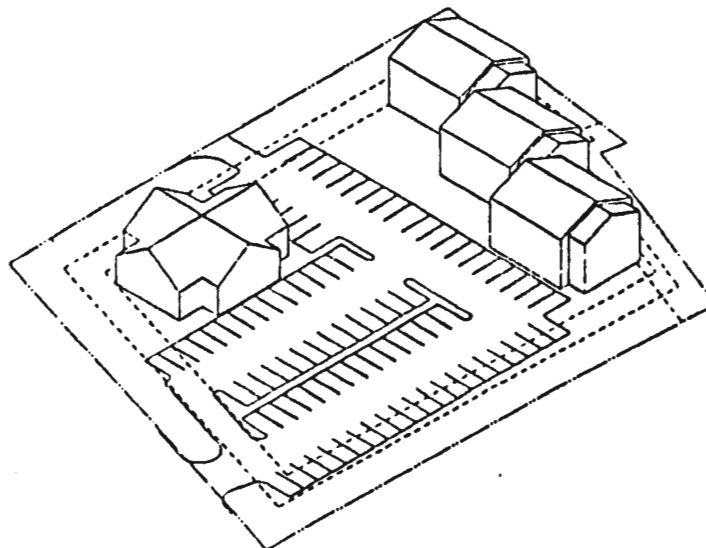
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PARALLEL VIEW SHOWING BUILDING FOOTPRINTS,
ELEVATION PROFILES AND SUPERIMPOSED SLABS
PRIOR TO ROTATION OF SLABS

(HIDDEN LINE OPERATION EXECUTED FOR CLARITY)

FIGURE 1

PARALLEL VIEW SHOWING SLABS
COPIED INTO POSITION

(HIDDEN LINE OPERATION EXECUTED FOR CLARITY)

FIGURE 2

MegaCADD by William Glennie
(Appropriate CADD)

Bill Glennie, who presented a slide show on MegaCADD, provided the following background. He originally became involved with computers due to his interest in solar energy, and has used AutoCAD since version 1.4 (or was it 1.7). Over the past number of years, Bill has used ten different CAD packages. He also teaches the use of CAD systems in courses at RPI.

Based upon experience, Bill indicated that one should learn and initially use CAD systems on a project which meets the following criteria:

(1) No time pressure;
(2) Zero importance; and
(3) Intimate familiarity.

Using the above as a basis, Bill showed slides illustrating the design of a greenhouse. The design, according to Bill, would have been difficult, if not impossible, to develop without CAD. The greenhouse was to be added to the back of a building in a historic district. Zoning approval for the green house was given under the restriction that it was not to be visible from the front. By using a 3D model, Bill altered the shape of the greenhouse such that from any view taken from the front it was not visible.

Bill indicated that a number of good rendering packages exist; however, very few good 3D modeling packages are available. Why do modeling?...A good 3D model provides the following benefits:

- Reduce amount of time for client approval;
- Reduce time for zoning approval;
- Have capacity for basically an infinite number of views;
- Identify design errors;
- Provide clear picture to builders; and
- Permit hand rendering over computer generated views, e.g. perspectives, elevations, etc.

Bill stated that about 15 years ago computer-generated 3D models would have required dedicated hardware costing on the order of $250,000. With the advances in microcomputer technology, the development of 3D models is now more available and cost-effective.

MegaCADD is a 3D modeling package which does not have or perform the following:

- Dimensioning
- Text
- Detailing
- Mechanical Drawing
- Complex modeling
- Ray Tracing
- Elaborate surface modeling
- Realistic imaging

MegaCADD also limits the number of objects to a maximum of 4,000 points. This requirement is enforced in order to retain the entire model in computer memory (RAM). As a result, the time for hidden line removal is significantly reduced.

Bill stated that even DataCAD has limits. For example, openings (voids) must pass completely through slabs, and limited editing can be performed on the vertices of slabs. (As a side note, Bill indicated he did use DataCAD for the development of construction drawings.)

Without the above capabilities, why would one consider using MegaCADD. Bill stated that unless you are a "*computer-friendly* user", the other capabilities can only increase the complexity of developing a 3D model. Of particular importance, MegaCADD can be learned in a very short period of time, i.e. hours not days or weeks.

Further, McgaCADD does support the following:

- Shading through an optional package which uses a single light source.
- Supports import/export of files in DXF.
- Perspective, plan, elevation, axonometric or isometric views.
- Multiple viewports, each of which may display a different view.
- Slide show preparation and display through an optional package.
- Bill of material generated from a model through an optional package. Reports are base upon attributes assigned to entities in models, or from predefined attributes associated with symbols from libraries available.
- Supports 124 graphics drivers, as well as any AutoCAD ADI drivers.

McgaCADD also supports a variety of 3D entities, such as square, rectangle, circle, "N-sided", free form. etc. Bill also indicated that the limit on the size of model which can be developed may be increased in a future release.

To illustrate the simplicity of use, Bill presented slide shows of several models which he had developed, including one developed as a demo for the computer users in an AIA chapter. The model had some complex roof conditions, but was completed within 8 hours.

During the course of the presentation, a drawing similar to that shown in Fig. 3 was illustrated for the purposes of testing the hidden line removal process. According to Bill, some CAD systems will remove one of the entities entirely in the hidden line removal process.

NOTE: *Since the drawing illustrated in Fig. 3 was developed in DataCAD, we can breathe a sigh of relief. The DataCAD hidden line removal process works correctly. Congratulations DataCAD development team at CADKEY...*
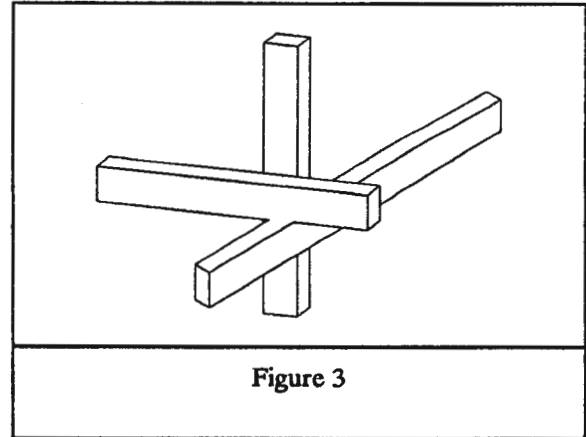

Figure 3

Architrion by Leo Murphy (Gimeor)

At ten o'clock, Leo Murphy was given the floor for his demonstration of Architrion running on a Mac. Leo initiated his presentation by drawing the configuration shown in Fig. 3, and then performed the hidden line removal process to illustrate that Architrion performed properly. It did!

He then included a ground plane (such as a slab or polygon placed at Z-Base). Establishing a light source, the shadows of the Fig. 3 configuration were then projected onto the ground plane.

Comments were raised immediately about the *"pop-up"* windows (or dialog boxes, as Leo referred to them). These were considered annoying to those who were used to the rather uncluttered Drawing Window of DataCAD. Leo responded that the most common commands could be invoked by single keystrokes or key sequences, much like DataCAD. In fact, single keys could be used to place the drawing in plan, section, elevation or wire frame.

A dialog box was, however, required to set up the parameters for perspective, such as viewer position, eye elevation, center of view and type of perspective (1, 2 or 3 point).

A rectangular 3D structure was then drawn and doors and windows inserted. The door and window elements used in Architrion provide information as to what should be displayed in plan and section. In the demonstration, the doors appeared as black opaque openings in a view other than plan and appeared as door and window elements in normal plan view.

With serious (?) prompting from the DBUG group, Leo was encouraged to place a dome on the structure. For this he had to revert to an earlier version of Architrion, primarily because the dialog boxes in the *beta test* version being used to this point were written in French and some of the keyboard shortcuts had been altered. The drawing was successfully transferred into the earlier version and a dome inserted onto the structure. (Editorial comment: Somewhat like covering a square hole with a round peg.)

By differing the viewing position, the model was viewed from various angles, including from inside looking up at the dome.

Rendering is possible in Architrion; however, surfaces are limited to single colors and not textures or degrees of opacity as in Velocity. Up to 256 colors are available for use and are selected from a palette.

In closing, Leo mentioned that upgrades are available about every four months at no charge. The cost of Architrion is about $2,500 for the color version which includes shading, hidden line removal, etc. A black and white version is available for about $900.

Geoff Langdon added that the cost of the hardware would be roughly equivalent to that of a 386.

Special thanks to Leo for being patient and presenting Architrion at such a late time and ON HIS BIRTHDAY. The remaining crew at the meeting gave him a rowdy (?) happy birthday chorus.

SUMMARY/NEXT MEETING

This was a fascinating meeting in which a lot of information was made available. We now have a glimmer of what other CAD systems are capable of doing. Thanks to Ivan Bereznicki Associates and Geoff Langdon for a well planned and executed meeting.

The next meeting will be hosted by C. L. Davis Consulting Associates in Middlebury, VT. The meeting will be in conjunction with the DataCAD User Group of Northern New England. The date and time are SATURDAY, October 21st at 1:00pm. The meeting will be in the Ilsley Library in the center of Middlebury. Parking is immediately behind the library and the entrance into the meeting room is from the parking lot.

The agenda for the meeting is as follows:

- Welcome/Introductions
- General Announcements Evan Shu, Rick Gleason and Ed Wolfstein
- CADKEY Educational Program: Norwich University and UVM
- Pencil Plotters by Mutoh
- PrintAPlot with Dot Matrix and Laser Plotters
- Rendering with A. T. & T. Targa by Jon-Clay Service Corp.

A map of Middlebury and Addison County was forwarded to you in an earlier notice. Should you need any further directions, please call.

PLEASE CALL (802) 388-7981 TO LET US KNOW THAT YOU ARE COMING.

Valle Blake (Architectural Design) will co-host this meeting and will host the one at Build Boston on November 15th at 3:00pm.

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DATACAD BOSTON USERS GROUP

BSA **A Committee of the Boston Society of Architects**

DBUG MEETING AGENDA : **Wednesday,** **September 20, 1989**

HOSTS : **Geoff Langdon,** Architectural CADD Consultants
Ivan Bereznicki, Ivan Bereznicki Associates

PLACE : **Ivan Bereznicki Associates, Inc.**
9 Wendell St.
Cambridge, MA 02138
617-354-5188

DIRECTIONS : See map on back of this page

AGENDA :

* **Ivan Bereznicki**
  - Welcome to DBUG Users and Background of the use of CADD at IBA

* **Geoff Langdon**
  - ArchCADD consulting, MultiCAD, Macintosh in the Arch Office for Desktop Pub., etc.

* **Announcements**
  - Pencil Plotter Demonstration, BSA Online Architect's Network, Build Boston'89, etc.

* **Bill Glennie from MegaCADD to show MegaModel**

* **Leo Murphy from Gimeor to show ArchitrionII**

* **Ivan Bereznicki to show DataCAD, DC Modeler**

* **Discussions : Relative merit of the various programs**

* **CADD in Architecture** videotape (time allowing)

MEMO
TO : Members of DBUG
FROM : Geoff Langdon and Ivan Bereznicki

The September meeting promises to be of particular interest to all members who are currently using or contemplating 3D CADD software.

Ivan Bereznicki Associates will be describing their recent experiences in implementing the DC Modeler. Additionally, we have invited two 3D CADD vendors (MegaCADD, with MegaModel for the IBM PS/2, and Gimeor, with Architrion for the Macintosh) to show us the capabilities of their systems.
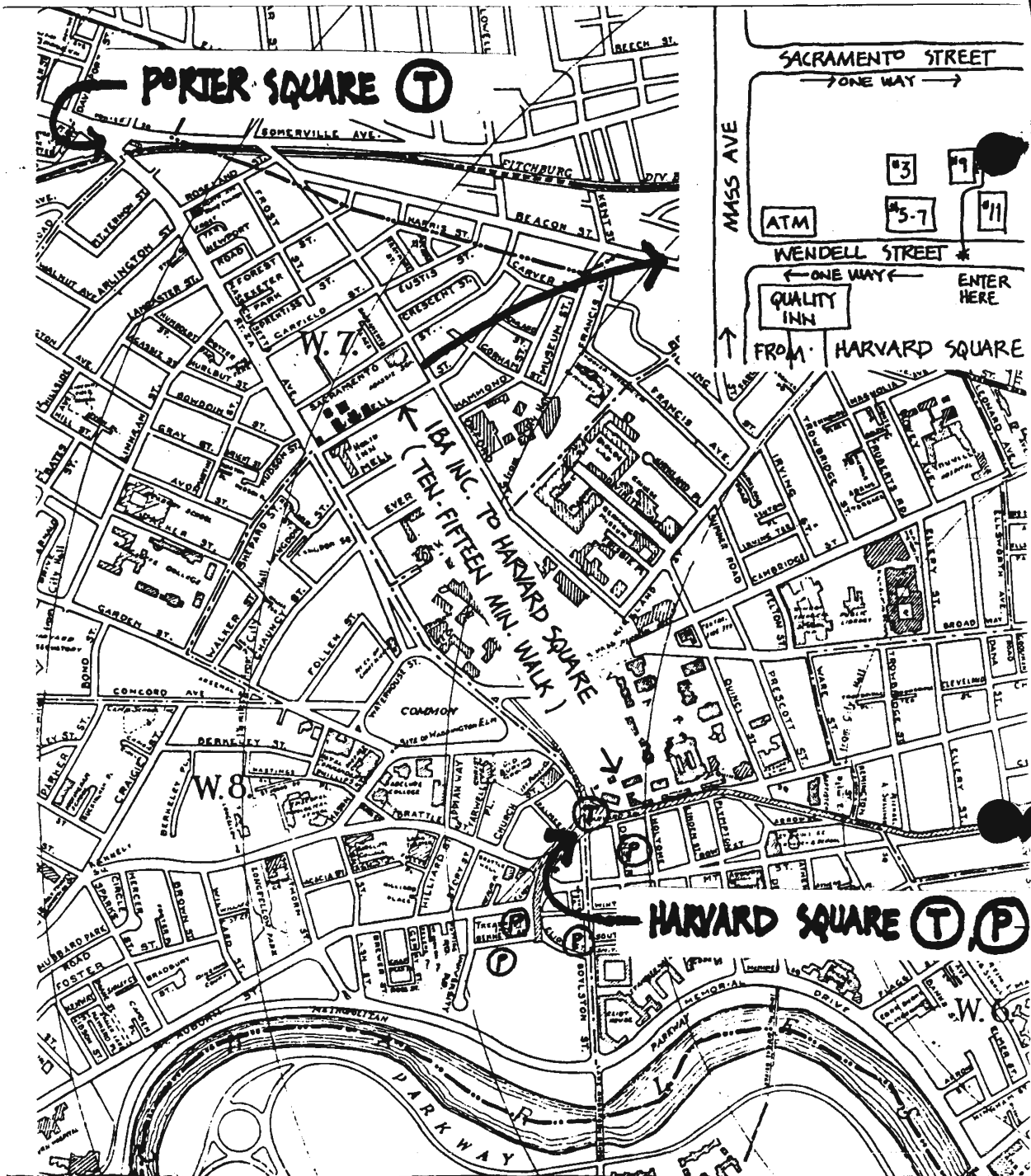The presentations will be followed by what we expect will be a lively discussion on the relative merits of the various 3D software systems.

We hope that in addition to being informative in their own right, these presentations will help us define abilities we want to see in future versions of the DC modeler.
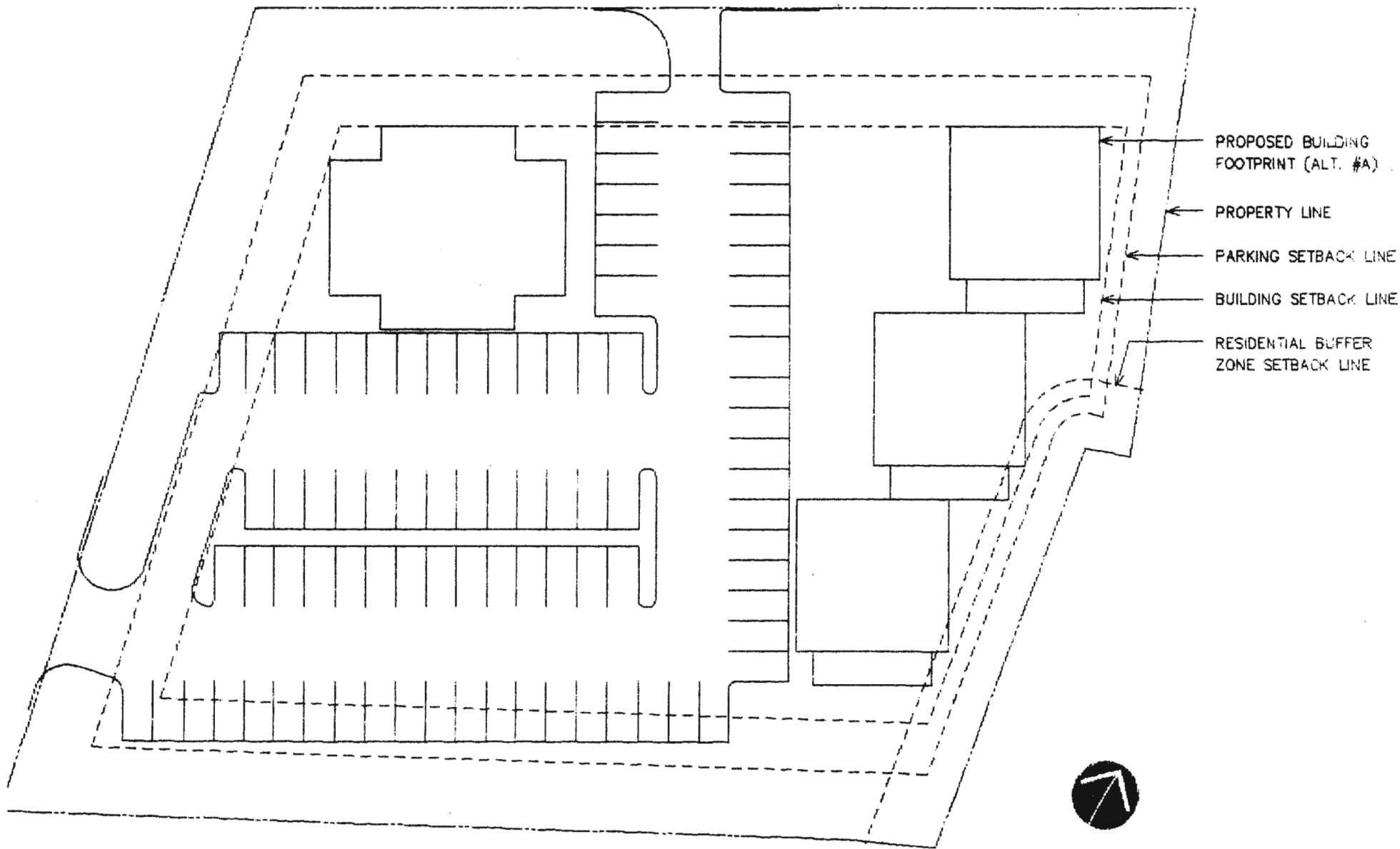

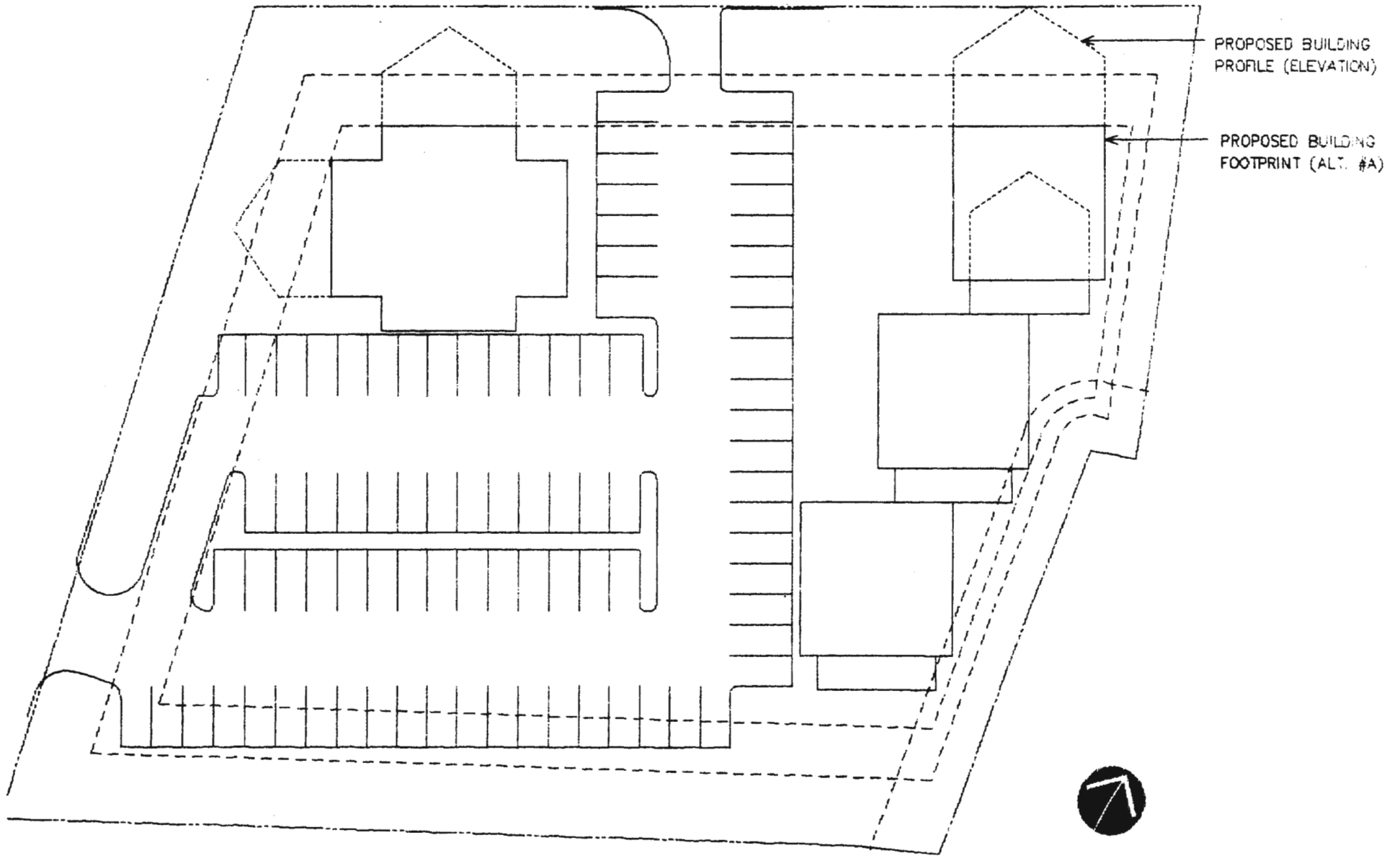## DIRECTIONS TO IVAN BEREZNICKI ASSOC. OFFICE

DRIVING:
1. On street parking for non-residents is available on Mass. Ave. and a few spaces closest to Mass. Ave. on most side streets. All other on-street parking is restricted for Cambridge residents only.
2. Public parking garages in Harvard Square are marked on the map.
3. We can provide a very limited number of parking spaces to people who cannot handle the walk from Harvard Square; please call in advance to reserve a space.
4. See note #4 below.

PUBLIC TRANSIT:
1. Red Line to Harvard Square or Porter Square
2. MBTA commuter rail from North Station to Porter Square
3. We are a 10 to 15 minute walk from Harvard or Porter Squares. Wendell Street is immediately to the north of the Quality Inn, a seven story 1960's building of brick and blue enameled steel panels which you cannot miss when walking along Mass. Ave.
4. If you don't want to walk, the Route 77 bus runs between Harvard and Porter Squares. You can catch it underground at the Harvard Square subway station. Ask to be let off at Wendell Street.

PROPOSED BUILDING
FOOTPRINT (ALT. #A)

PROPERTY LINE

PARKING SETBACK LINE

BUILDING SETBACK LINE

RESIDENTIAL BUFFER
ZONE SETBACK LINE

SITE PLAN SHOWING BUILDING FOOTPRINTS

PROPOSED BUILDING
PROFILE (ELEVATION)

PROPOSED BUILDING
FOOTPRINT (ALT. #A)

SITE PLAN SHOWING BUILDING FOOTPRINTS
AND ELEVATION PROFILES

SLAB W/HGT. OF 70'-0"
SHOWN IN ORTHO (PLAN)
VIEW.

SLAB W/HGT. OF 60'-0"
SHOWN IN ORTHO (PLAN)
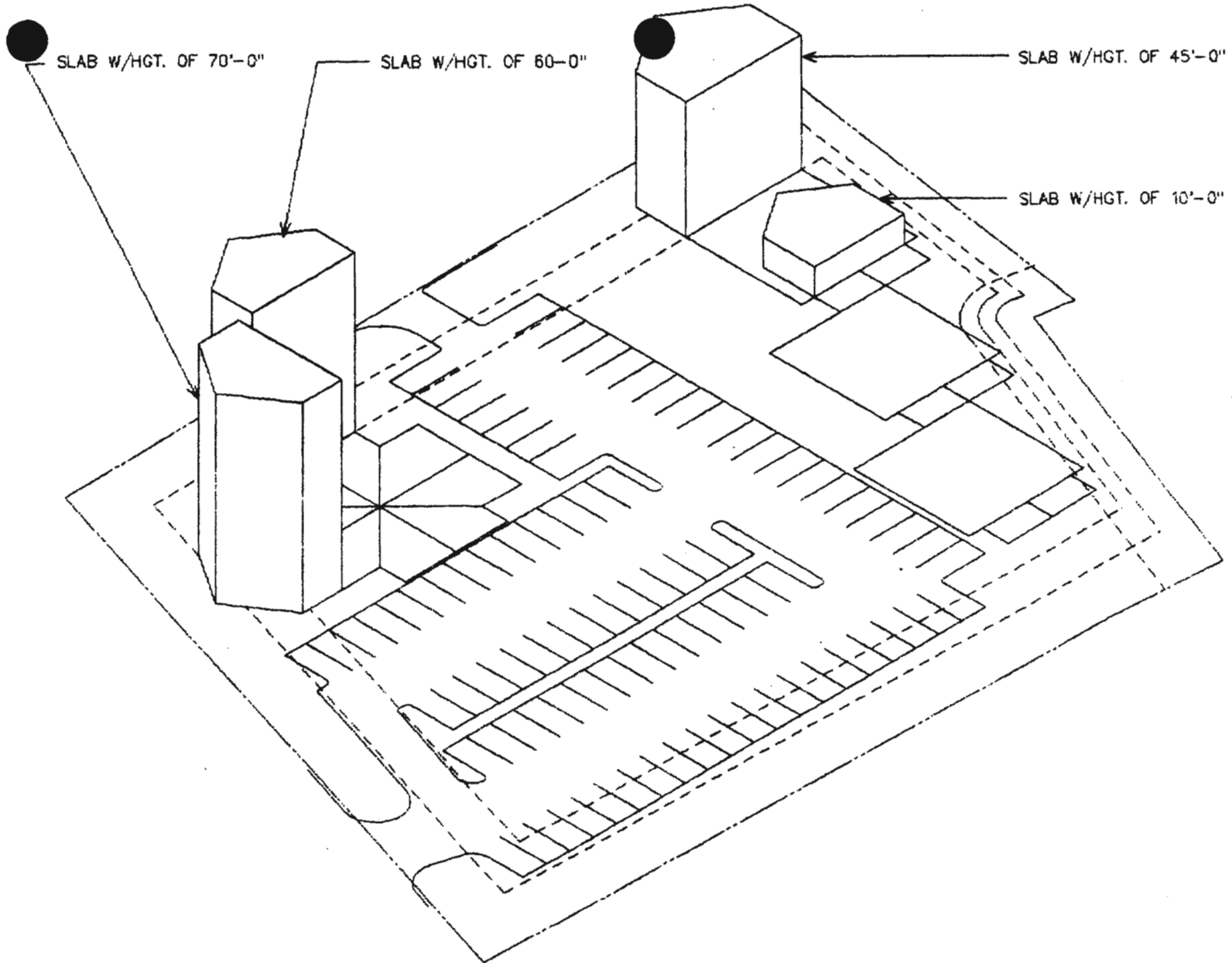VIEW.

SLAB W/HGT. OF 45'-0"
SHOWN IN ORTHO (PLAN)
VIEW.

SLAB W/HGT. OF 10'-0"
SHOWN IN ORTHO (PLAN)
VIEW.

NOTE: 3D SLABS ARE CONSTRUCTED
ON A NEW LAYER BY SNAPPING
TO THE POINTS WHICH DEFINE
THE BUILDING PROFILE (ELEVATION).

ORTHO VIEW SHOWING BUILDING FOOTPRINTS,
ELEVATION PROFILES AND SUPERIMPOSED SLABS
PRIOR TO ROTATION OF SLABS

SLAB W/HGT. OF 70'-0"

SLAB W/HGT. OF 60-0"

SLAB W/HGT. OF 45'-0"
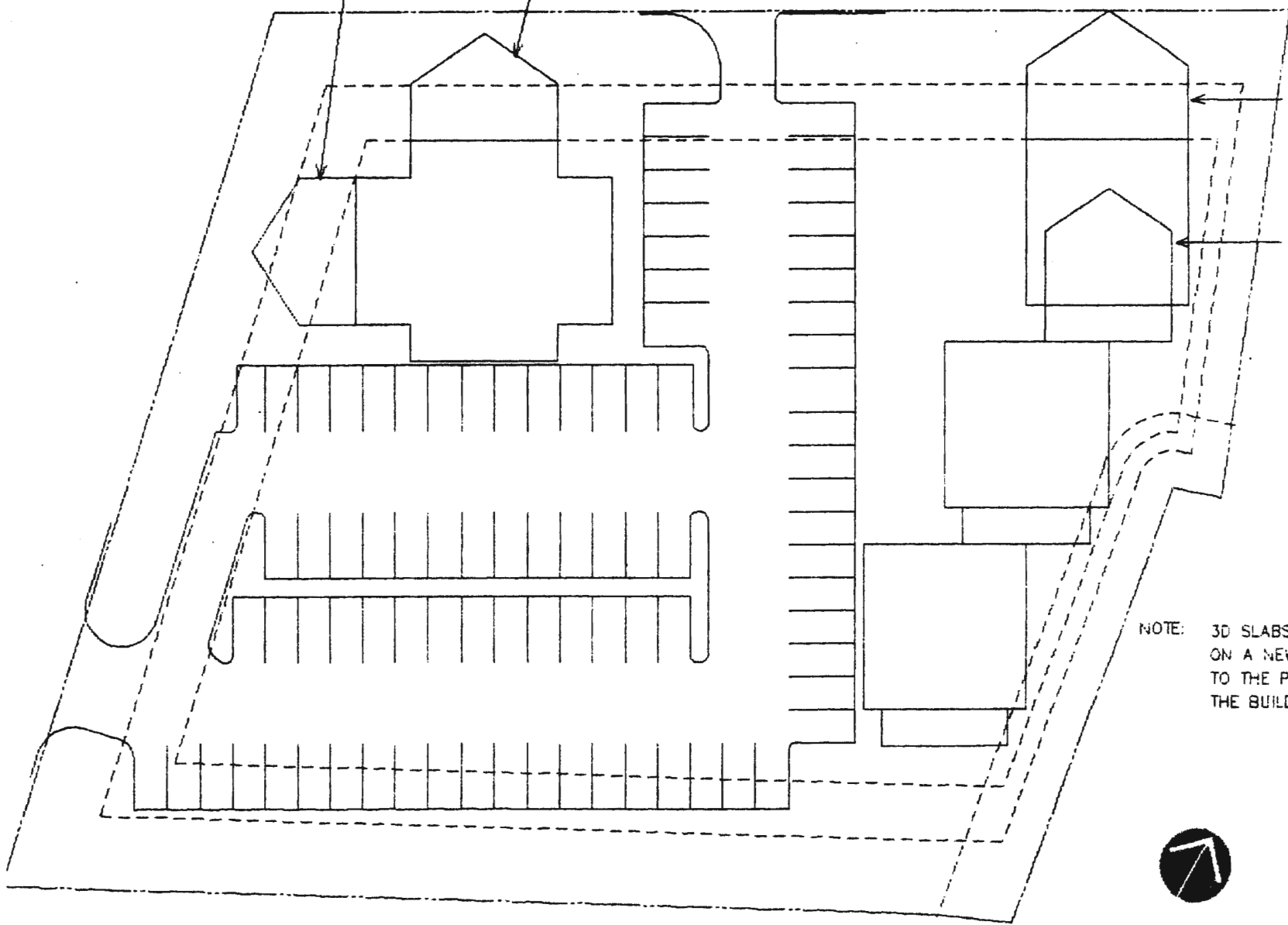
SLAB W/HGT. OF 10'-0"

PARALLEL VIEW SHOWING BUILDING FOOTPRINTS,
ELEVATION PROFILES AND SUPERIMPOSED SLABS
PRIOR TO ROTATION OF SLABS

(HIDDEN LINE OPERATION EXECUTED FOR CLARITY)

SLAB W/HGT. OF 70'-0"
ROTATED INTO POSITION
ABOUT THE Y AXIS.

SLAB W/HGT. OF 60'-0"
ROTATED INTO POSITION
ABOUT THE X AXIS.

BUILDING PROFILE, DRAWN
ON SEPARATE LAYER, CAN
NOW BE TURNED OFF.

SLAB W/HGT. OF 45'-0"
ROTATED INTO POSITION
ABOUT THE X AXIS.

SLAB W/HGT. OF 10'-0"
ROTATED INTO POSITION
ABOUT THE X AXIS.
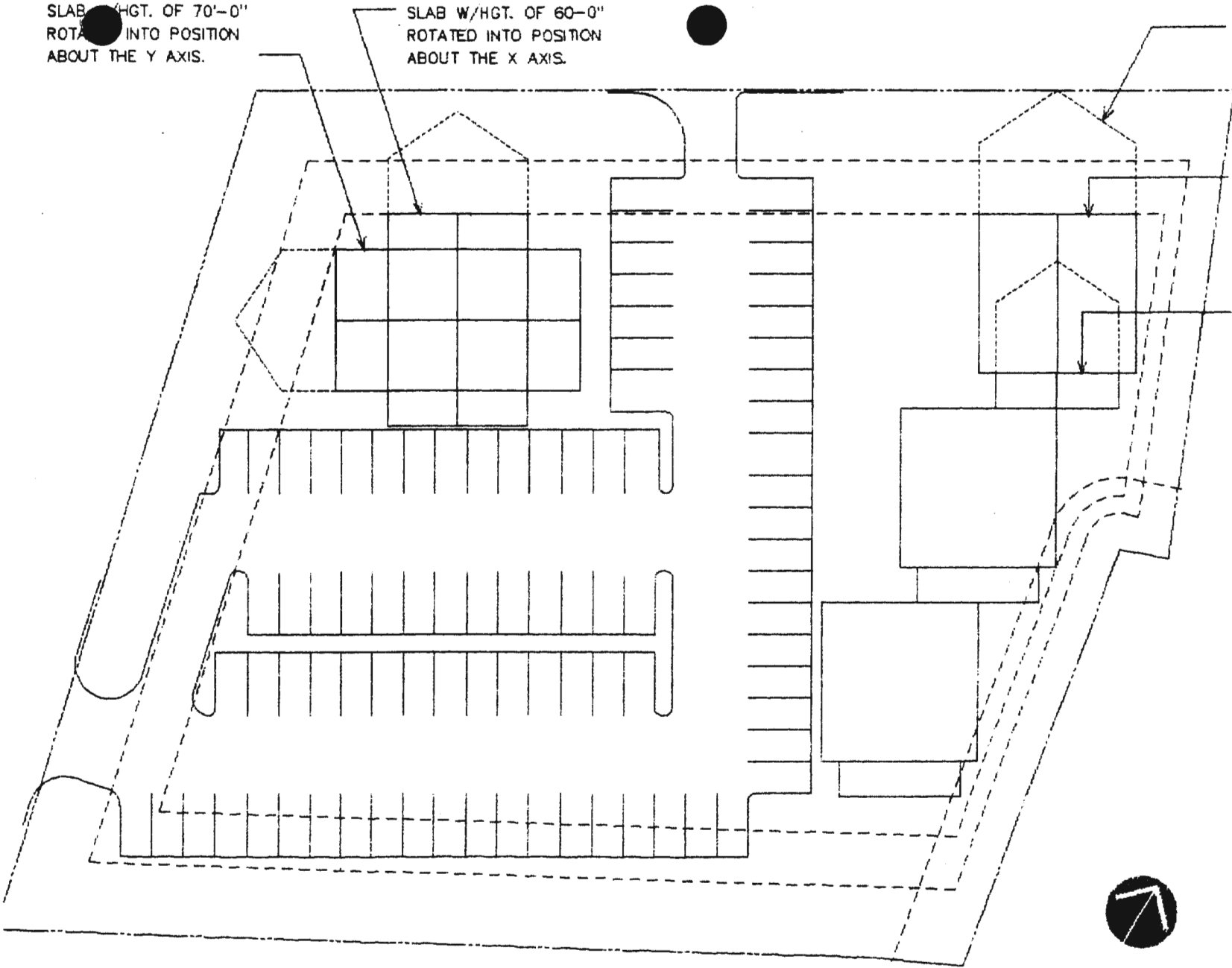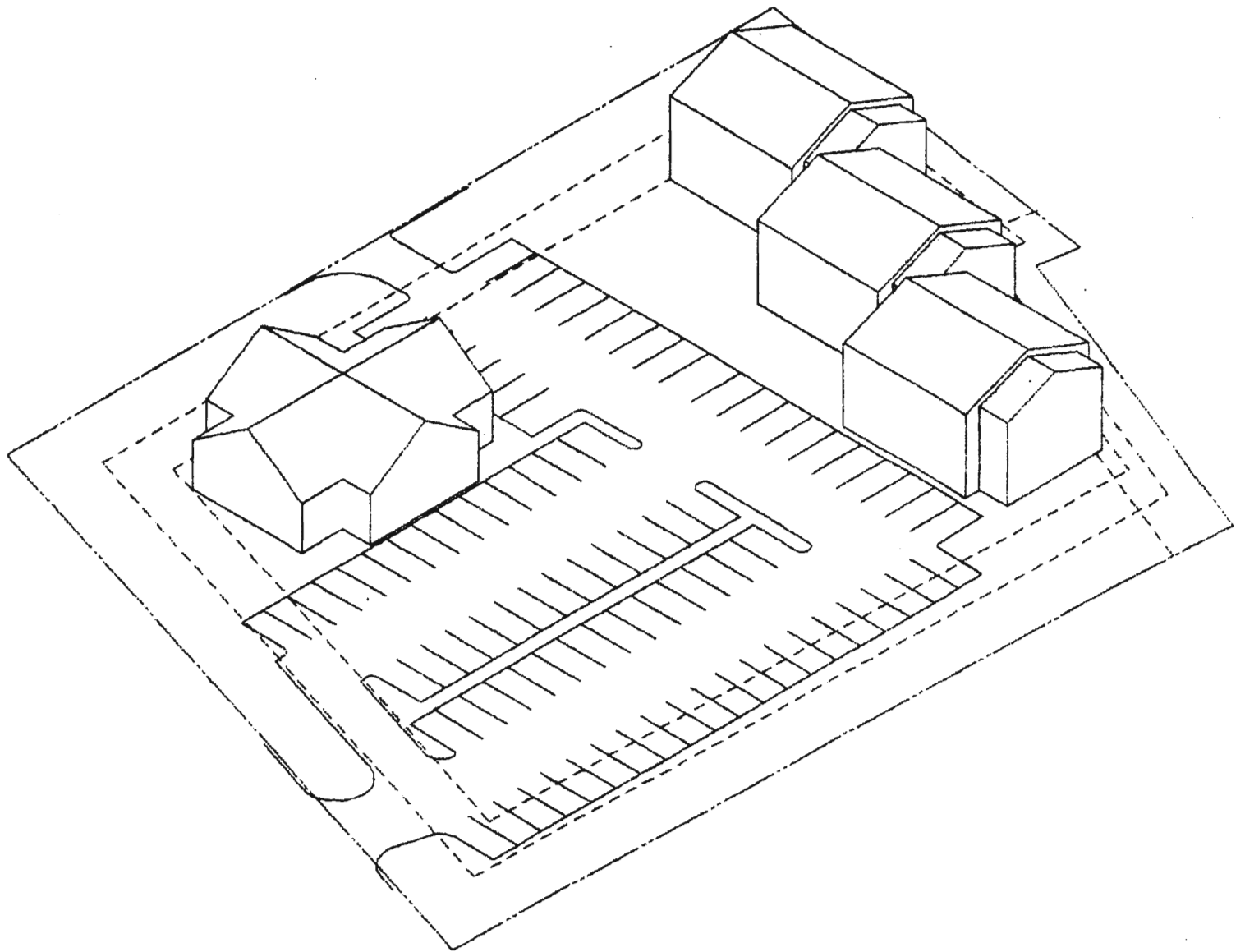
ORTHO VIEW SHOWING SLABS
ROTATED INTO POSITION

NOTE: WHEN TWO OR MORE SLABS ARE
MADE TO INTERSECT, FAIRLY COMPLEX
ROOF FORMS CAN BE CONSTRUCTED
USING VERY SIMPLE STEPS. YOU WILL
NOTE HOWEVER, THAT THE PROGRAM
WILL NOT DELINEATE THE INTERSECTION
OR TWO PLANES WITH A LINE (I.E.,
THE ROOF VALLEYS). THESE MUST
BE DRAWN IN AFTER THE VIEW
HAS BEEN SAVED (CONVERTED TO A
2D DRAWING).
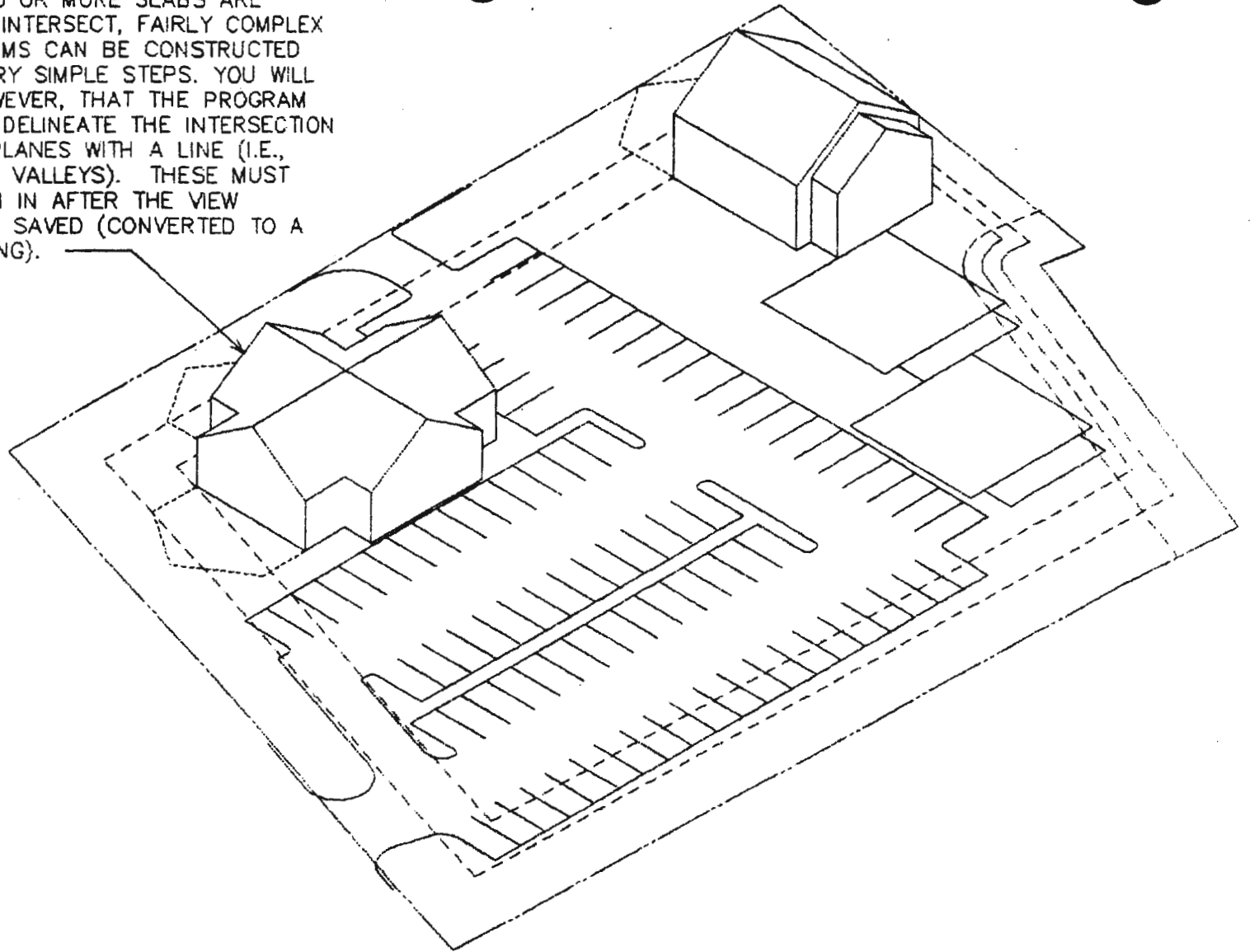
PARALLEL VIEW SHOWING SLABS
ROTATED INTO POSITION
(HIDDEN LINE OPERATION EXECUTED FOR CLARITY)

SLAB W/HGT. OF 45'-0"
ROTATED INTO POSITION
ABOUT THE X AXIS.

SLAB W/HGT. OF 10'-0"
ROTATED INTO POSITION
ABOUT THE X AXIS.

3-D ENTITIES CAN BE MANIPULATED
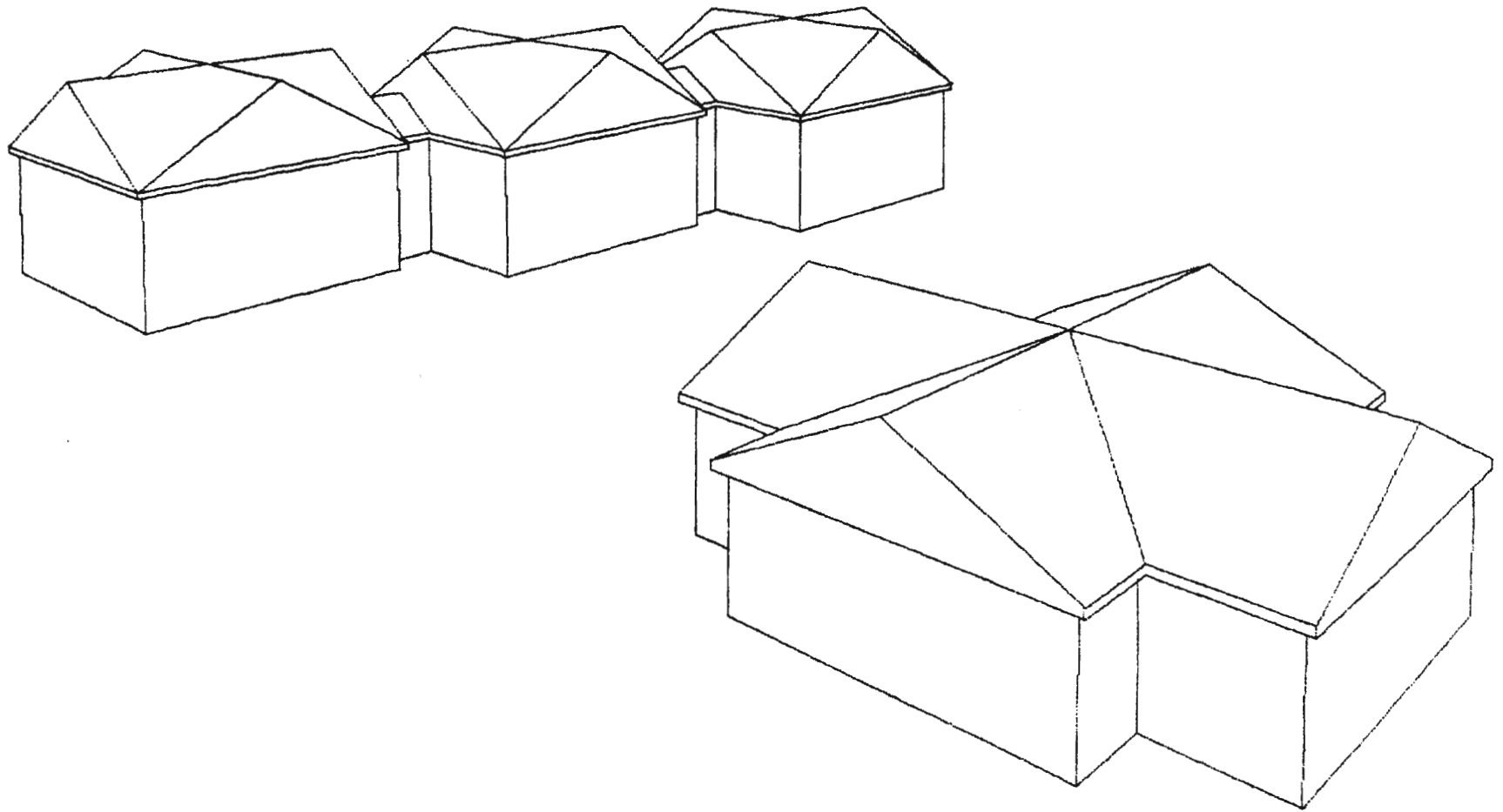THE SAME AS 2-D ENTITIES; MOVE,
STRETCH, COPY, ETC.
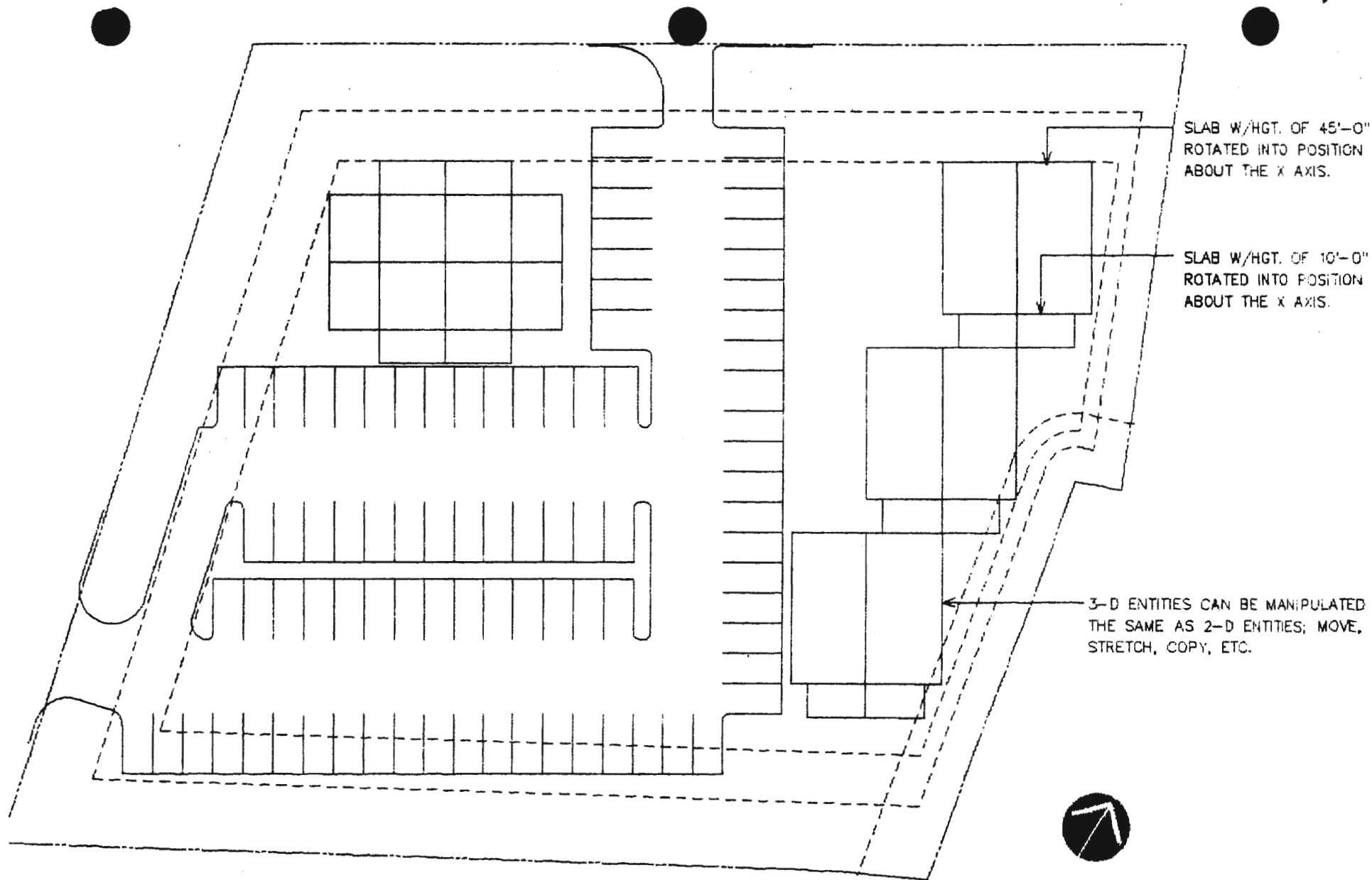
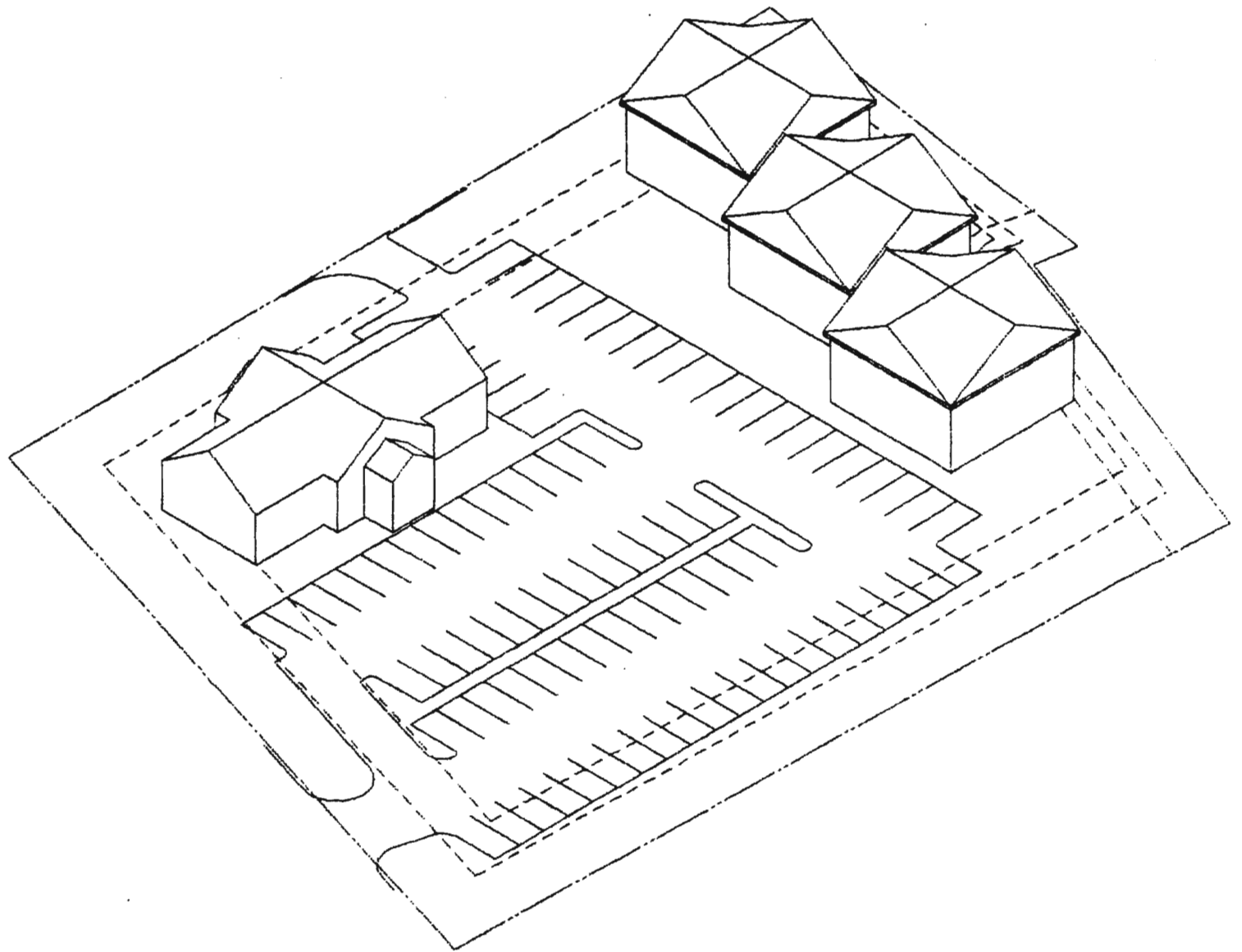ORTHO VIEW SHOWING SLABS
COPIED INTO POSITION

PARALLEL VIEW SHOWING SLABS
COPIED INTO POSITION
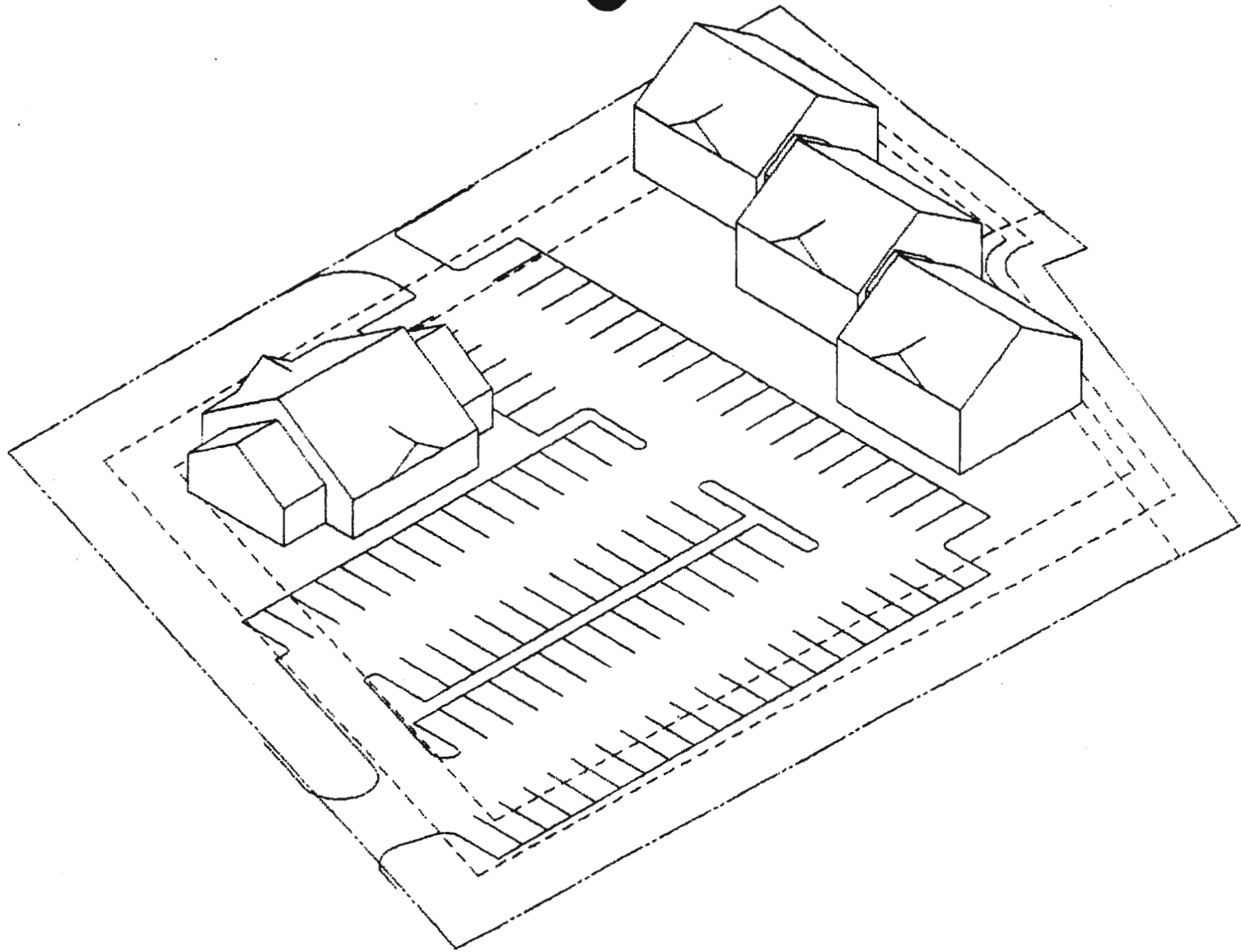(HIDDEN LINE OPERATION EXECUTED FOR CLARITY)
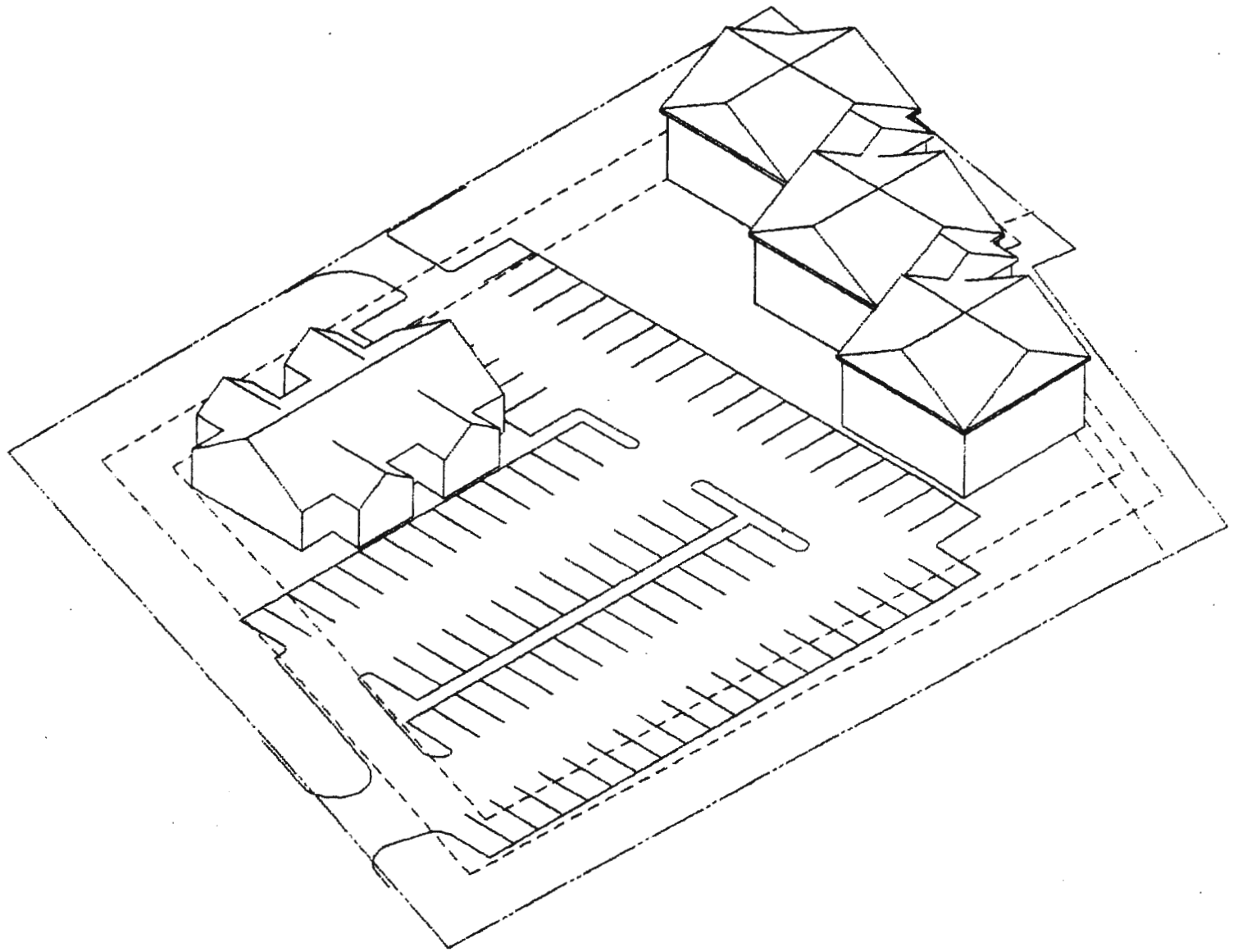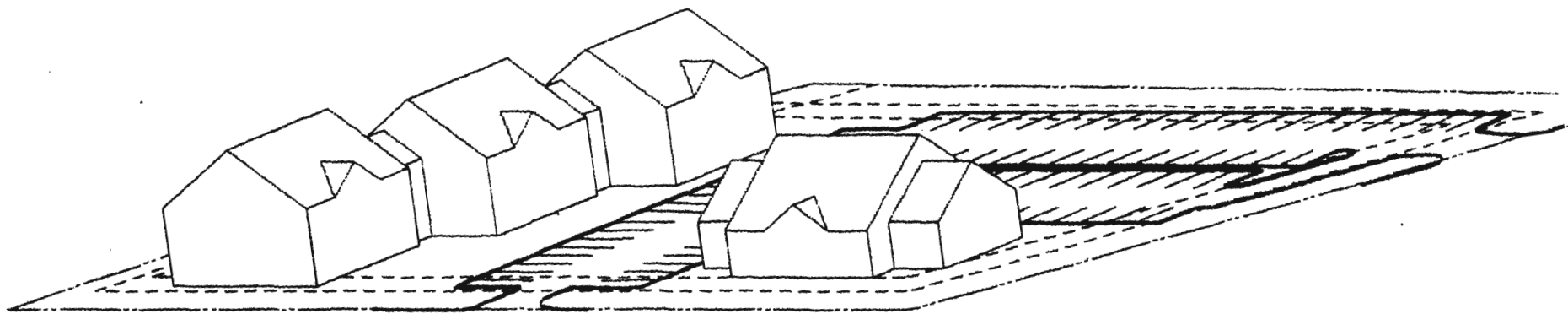
PARALLEL VIEW — DESIGN DEVELOPMENT

PERSPECTIVE VIEW — DESIGN DEVELOPMENT

PARALLEL VIEW — DESIGN DEVELOPMENT

PARALLEL VIEW – DESIGN DEVELOPMENT

PARALLEL VIEW — DESIGN DEVELOPMENT