Chapter 17

A unified model for building

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It is commonly recognized that the time-honoured procedure for preparing an architectural design for building on site is inefficient. Each member of a team of consultant professionals makes an independently documented contribution. For a typical project involving an architect and structural, electrical, mechanical and public services engineers there will be at least five separate sets of general-arrangement drawings, each forming a model of the building, primarily illustrating one discipline but often having to include elements of others in order to make the drawing readable. For example, an air-conditioning duct-work layout is more easily understood when superimposed on the room layout it serves which the engineer is not responsible for but has to understand.

Both during their parallel evolution and later, when changes have to be made during the detailed design and production drawing stages, it is difficult and time consuming to keep all versions coordinated. Complete coordination is rarely achieved in time, and conflicts between one discipline and another have to be rectified when encountered on site with resulting contractual implications. Add the interior designer, the landscape architect and other specialized consultants at one end of the list and contractors' shop drawings relating to the work of all the consultants at the other, and the number of different versions of the same thing grows, escalating the concomitant task of coordination.

The potential for disputes over what is the current status of the design is enormous, first, amongst the consultants and second, between the consultants and the contractor. When amendments are made by one party, delay and confusion tend to follow during the period it takes the other parties to update their versions to include them.

The idea of solving this problem by using a common computer-based model which all members of the project team can directly contribute to is surely a universally assumed goal amongst all those involved in computer-aided building production.

The architect produces a root drawing or model, the 'Architect's base plan', to which the other consultants have read-only access and on top of which they can add their own write-protected files. Every time they access the model to write in the outcome of their work on the project they see the current version of the 'Architect's base plan' and can thus respond immediately to recent changes and avoid wasting time on redundant work. The architect meanwhile adds uniquely architectural material in his own overlaid files and maintains the root model as everybody's work requires. The traditional working pattern is maintained while all the participants have the ability to see their colleagues' work but only make changes to those parts for which they are responsible.
The file structure might be as follows:

Active file	*Read-only file*
Architect base	. .

Architect loading	Architect base
Architect detail plan	Architect base
Structural: steel	Architect base
Structural: concrete	Architect base
Architect ceiling base	Architect base
Architect ceiling loaded	Architect base Ceiling base
Architect ceiling void	Architect base Ceiling base
Services: mechanical	Architect base Ceiling base Ceiling void
Services: electrical	Architect base Ceiling base Ceiling void
Services: piped	Architect base Ceiling base Ceiling void
Services: drainage	Architect base

The files would be based on an at least partly three-dimensional system to provide the facility for the detection of conflicts between any elements in any different files.

Any discipline would have the facillity to bring up any combination of the files of the others in addition to the files necessary as background to their own.

When the project comes to being built the model is ready to accept the 'shop drawings' which have to be made by many of the subcontractors who between them create the finished building. Buildings are built from shop drawings, not from the consultants' drawings, because they represent the subcontractors' drawings understanding of what is wanted and his contractural undertaking to provide it. By adding to the shared computer model the task of providing shop drawings is made easier by the fact that only the additional production information over and above what already exists on the model need be added. There is no reason why the resulting files with their due protection should not be just as tangible contractual documents as the traditional murky dye-line prints while the plotted versions would become waste paper as soon as they have served their purpose. The architect's role in checking and coordinating is, of course, infinitely easier without paper.
A typical shop drawing file structure might be as follows:

Active File	*Read-only files*
Duct-work subcontractor	Services: mechanical Architect base Architect ceiling base Architect ceiling void

The technical means of achieving this within the constraints of a commercial working environment now exist. Not only has modelling software generally developed to a state of user friendliness such that one does not

need programming skills to make use of it, the real cost of computing systems capable of modelling buildings is dropping year by year. A practice which could until recently only afford a microcomputer for word processing, accounting and calculation can now contemplate a system for carrying out actual building-modelling work.

Multi-disciplinary practices pioneered the expansion of computer modelling from one discipline to several. However, this method of practice, which is supposed to shortcut the problems of coordinating different disciplines, has not spread as widely as was originally expected. Many such practices find that their departments do as much work independently as they do together as a multi-disciplinary team. A centralized computer installation, such as a series of terminals attached to a mainframe computer, can provide the multi-disciplinary team based in one office with the facility to relate directly to one model. However, when the team is physically dispersed in different offices the direct link-up is more difficult and costly.

This suggests that a future working convention of using shared computer models must either be project based, where a project manager, ideally also the architect, provides a system which the various independent consultants make use of for the duration of the project. Alternatively, and more likely, it will be achieved through the linking together or 'networking' of the participants' own computers in such a way that a shared model is created.

Inevitably, potential members of a project team will rarely have the same computer systems at their disposal. Software for translating files between different systems has been written but it is necessarily complicated on account of fundamental differences in file structures and manipulative routines. Cooperation on this front between the main computer companies has been minimal, presumably because, being commercial enterprises, they are more concerned with outselling their competitors than co-existing with them. Translation programs are either written by third parties or the producers of smaller systems anxious not to lose customers on account of being incompatible with other larger systems. The process tends to result in the breakdown of the files into their simplest or lowest-level graphic components and in the loss of database linkages.

The existence of a number of different systems on the market will continue, each developing towards its own version of a complete modelling facility for building design production. However, it will undoubtedly always be worth someone's while to develop the necessary links for the working of shared models made up of contributions from independent consultants working on different systems in separate offices.

Possibly a much more fundamental obstacle to the working of a shared computer models than the technical ones is the gaining of its universal adoption, not only amongst the consultant professions but also amongst the building industry at large. By acceptance we mean a sufficiently complete understanding of the principles of a shared model to cause a change of attitude towards the use of the computer from something which is seen merely as an add-on facility running in parallel to and augmenting the established method of working to something which becomes exclusively relied on as the method itself. Experience shows that it is difficult

enough to bring about this change amongst the design team let alone extending it to include the whole building industry.

Some of the pitfalls familiar in architects' offices are as follows:

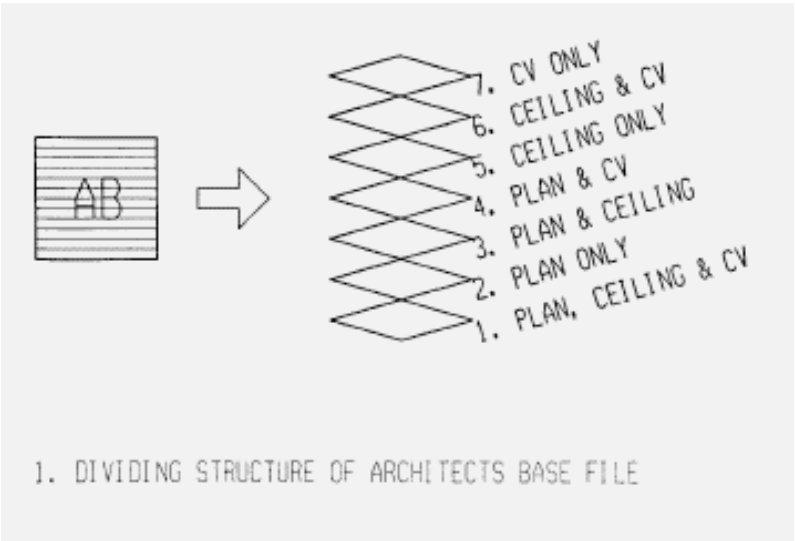
(1) Lack of trust of the computer model until a plot is 'in the hand'. This can cause the loss of a productively interactive relationship with it and failure to exploit the possibilities of multiple output (e.g. plots at different scales and showing varying amounts of information). People will only come to understand that the end-product is not the plotted drawing but the model on the system by using it directly and discovering its possibilities first hand.

(2) When under the pressure of meeting deadlines with a finite computer capacity, resorting to expedient shortcuts which downgrade aspects of the model from levels of interactive complexity to basic drawn or written elements. Such higher-level aspects of a model have to be protected from irresponsible dismantling while being improved to obviate the necessity for such measures. A graphically related database, unless well proved and adequately protected, can all too easily fall victim to irretrievable degradation.

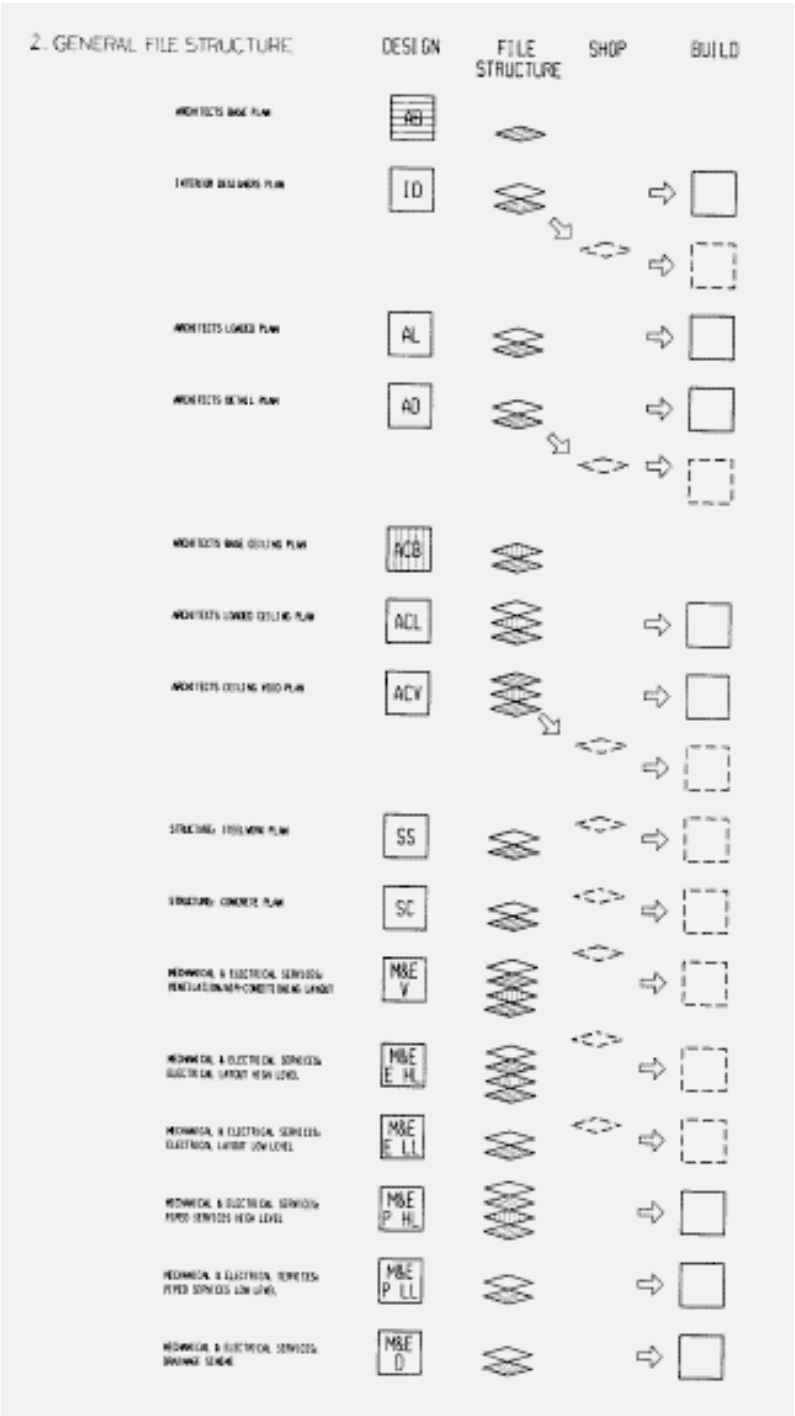
(3) The failure to train the complete project team to a reasonable degree of familiarity with its system. This usually results in the effective creation of a bureau situation within the team, misunderstandings between the managing and productive team members, the duplication of work and lost opportunities for exploiting the potential of the computer model.

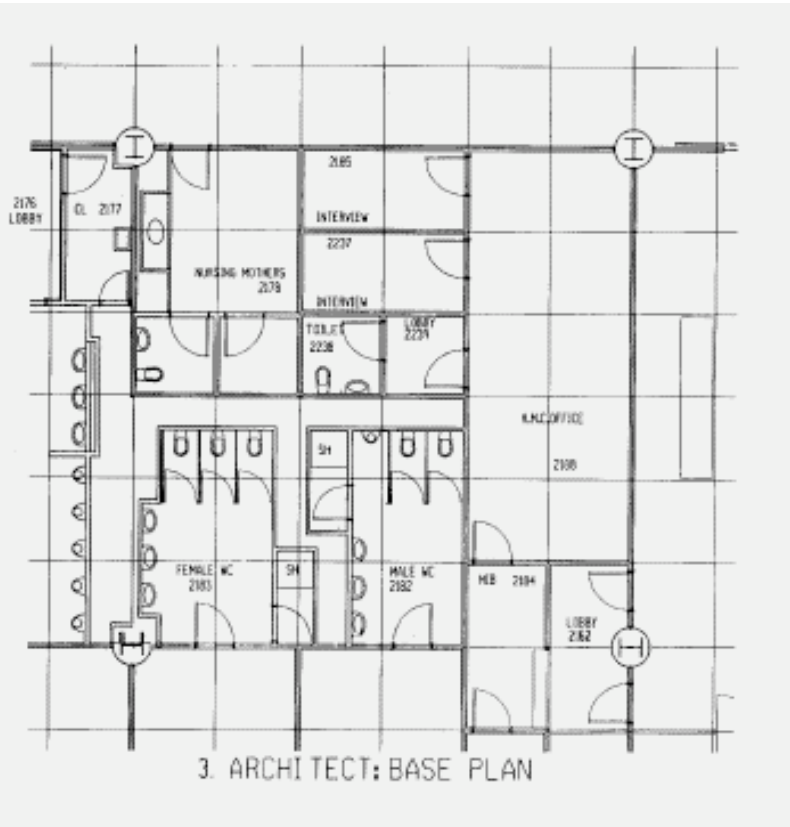
(4) Architects have often been over-optimistic in trying to instigate the principle of a shared computer model amongst the project team without having the authority that they would have if, say, the client made full participation a condition of each consultant's engagement. A carefully set-up computer model can rapidly be rendered useless by the reversion to manual drawings by any one of the participants.

Systems will, however, continue to be developed along lines which make them easier to use and more and more difficult to misuse. The advantage to be gained in terms of increased efficiency resulting from their correct applications must eventually become irresistable to all but the most ingrained traditionalists who will risk bankruptcy as a result of their narrowmindedness.

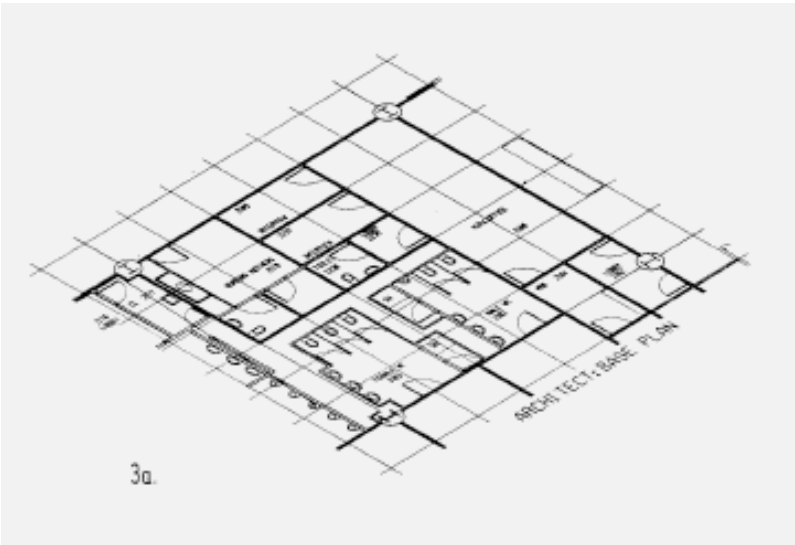


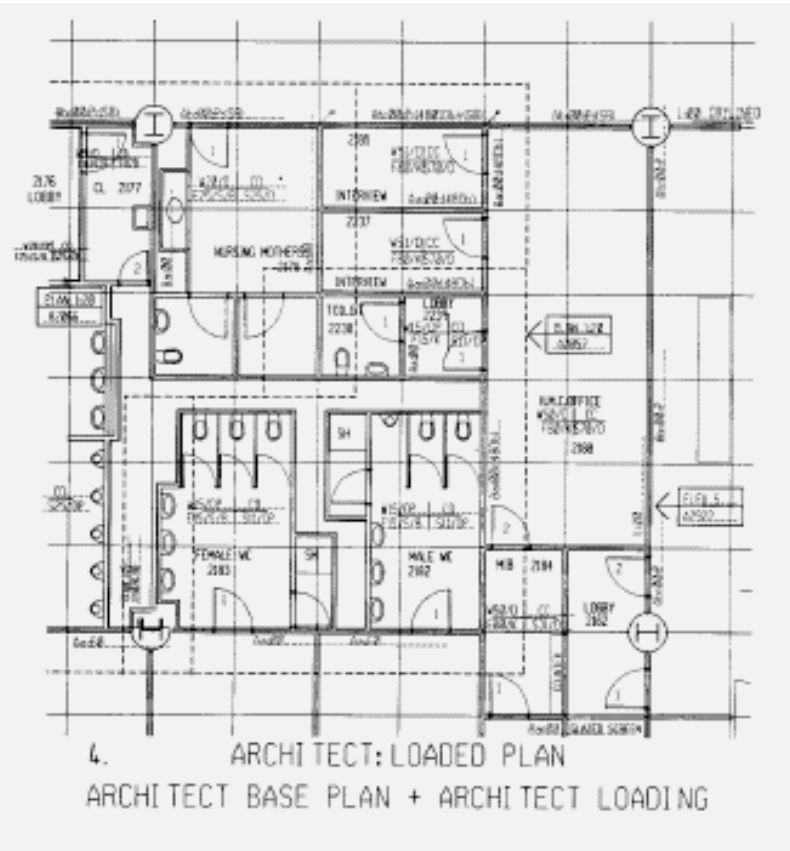
1. DIVIDING STRUCTURE OF ARCHITECTS BASE FILE


2. GENERAL FILE STRUCTURE
DESIGN
FILE STRUCTURE
SHOP
BUILD
AB
ID
AL
AD
ACB
ACL
ACV
SS
SC
M&E V
M&E E HL
M&E E LL
M&E P HL
M&E P LL
M&E D



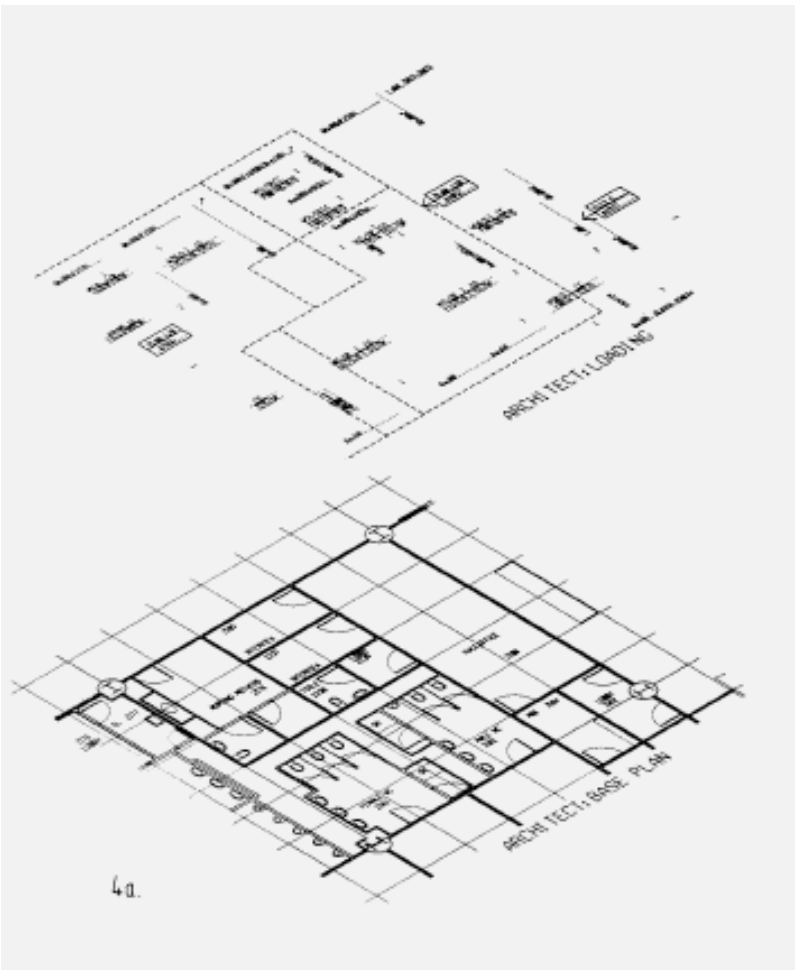
3. ARCHITECT: BASE PLAN

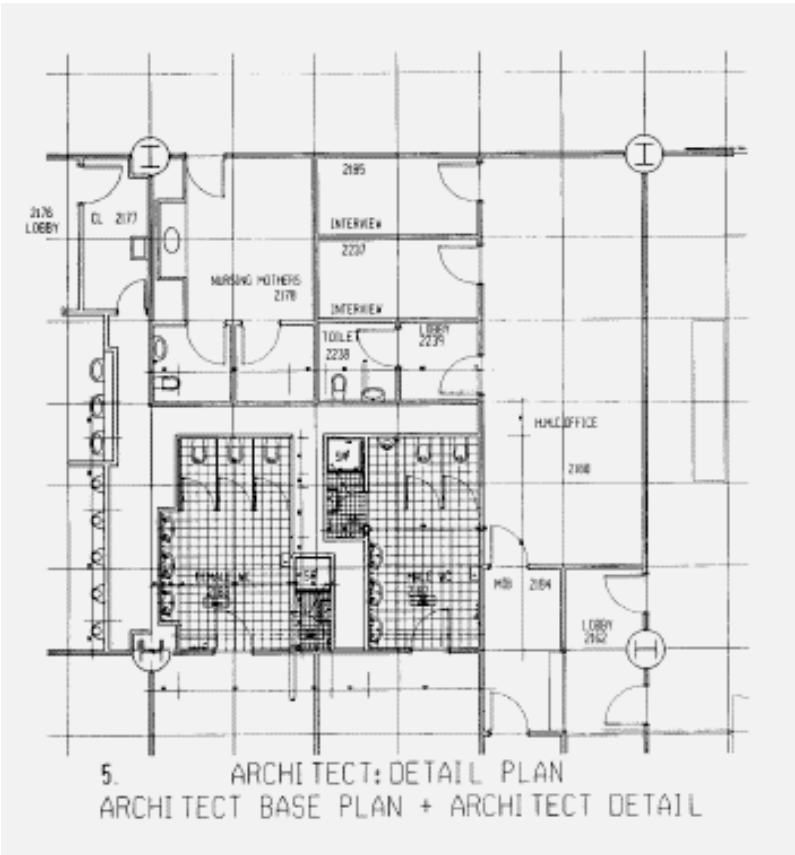

ARCHITECT: BASE PLAN
3a.



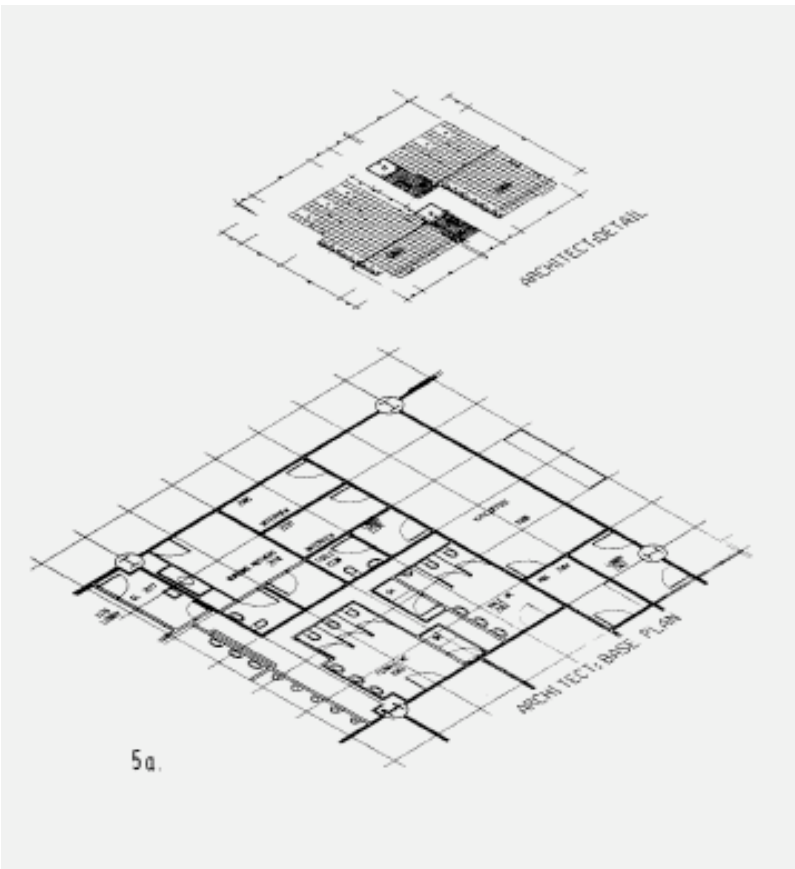
4. ARCHITECT: LOADED PLAN

ARCHITECT BASE PLAN + ARCHITECT LOADING

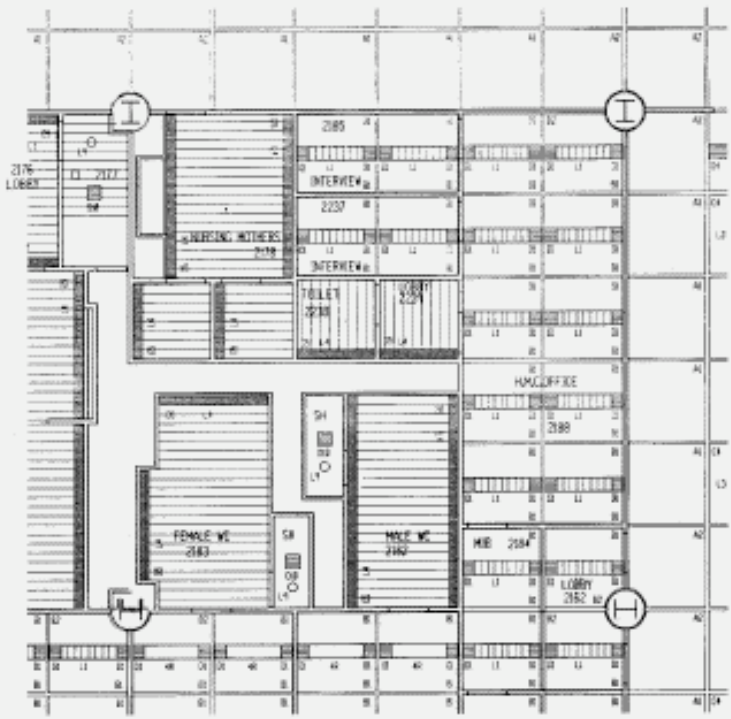

ARCHITECT: LOAD[ING]
ARCHITECT: BASE PLAN
4a.



5. ARCHITECT: DETAIL PLAN
ARCHITECT BASE PLAN + ARCHITECT DETAIL

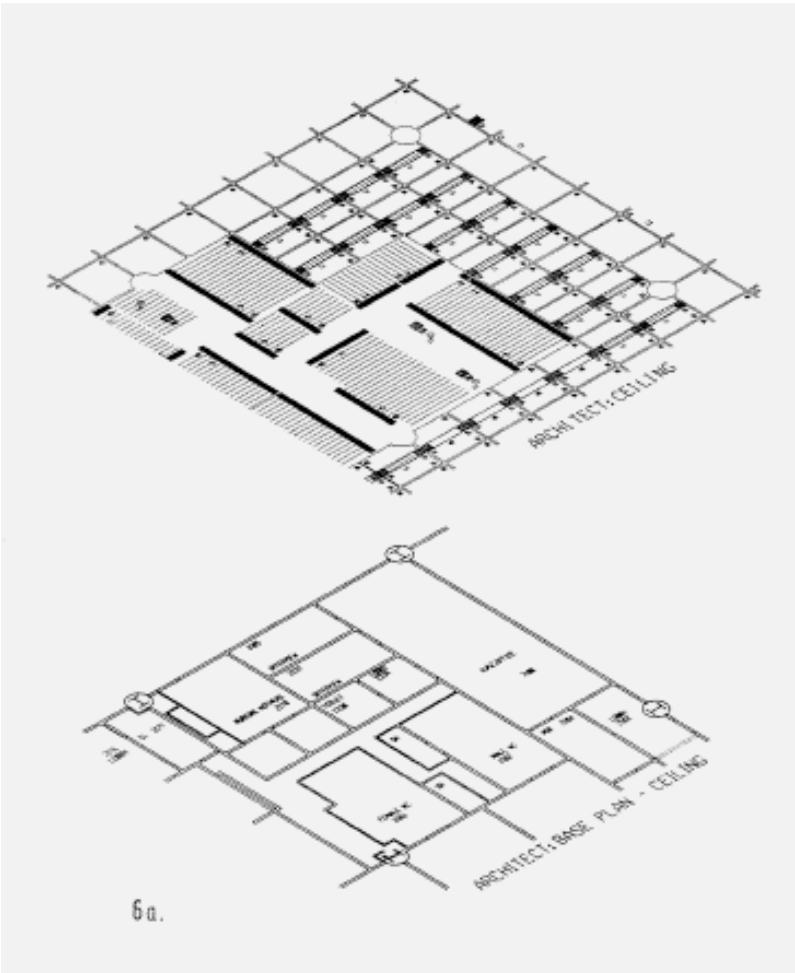


5a.



6. ARCHITECT: CEILING PLAN

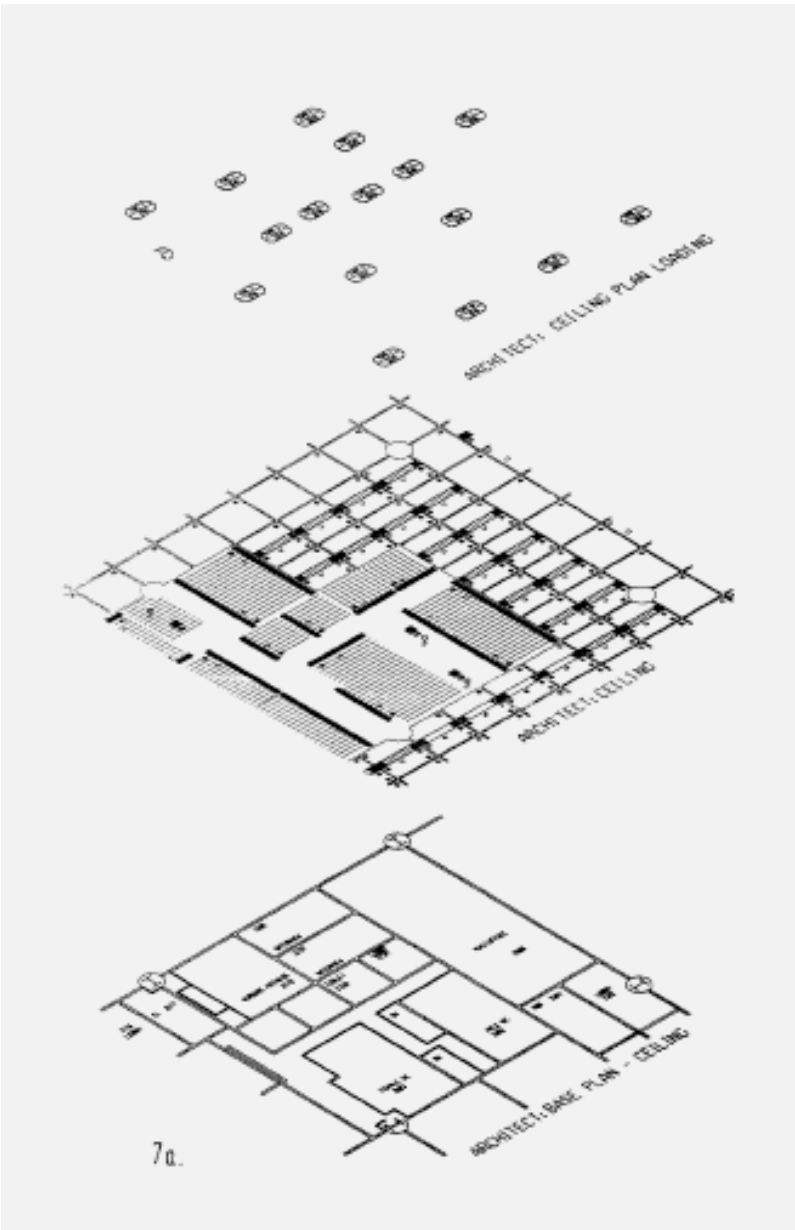
ARCHITECT: BASE PLAN + ARCHITECT: CEILING

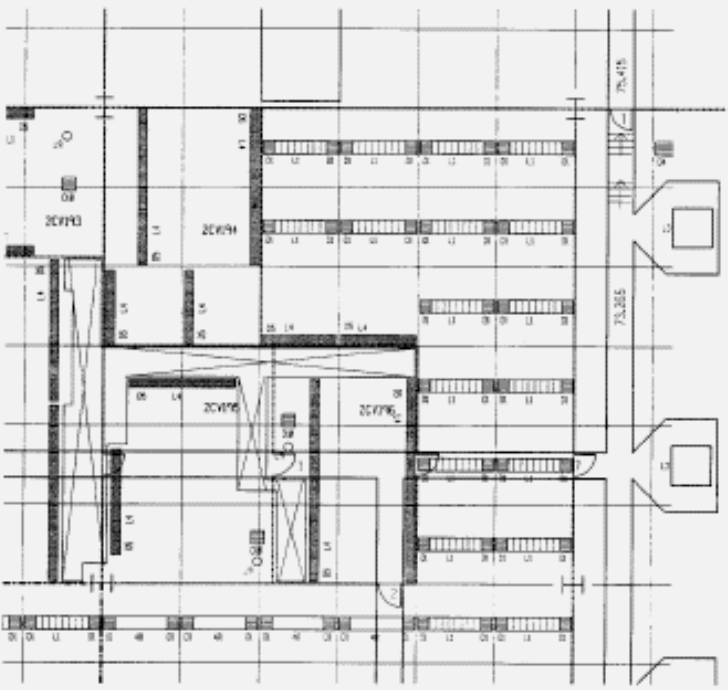


6a.

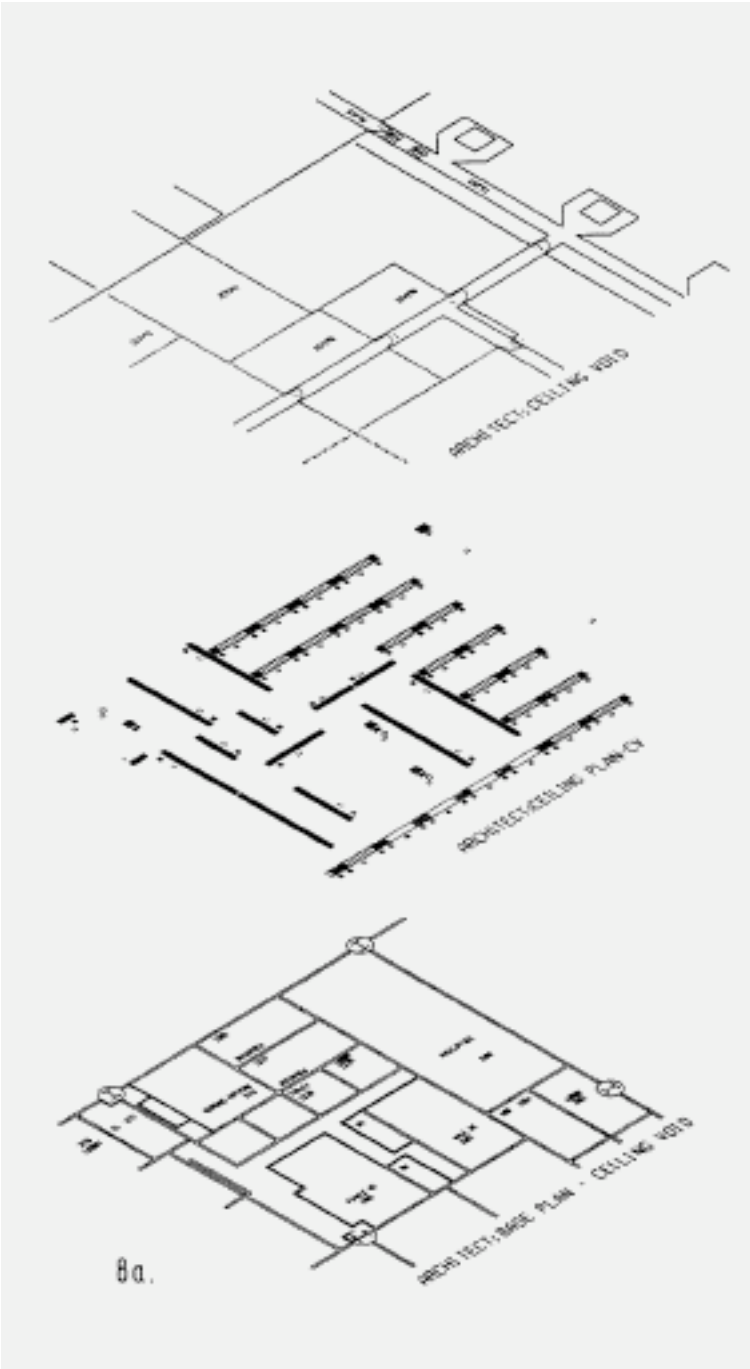
7. ARCHITECT: LOADED CEILING PLAN

ARCHITECT: BASE PLAN-CEILING + CEILING + LOADING


ARCHITECT: CEILING PLAN LOWERING
ARCHITECT: CEILING
ARCHITECT: BASE PLAN - CEILING
7a.



8. ARCHITECT: CEILING VOID PLAN
ARCHITECT: BASE-CV + ARCHITECT: CV



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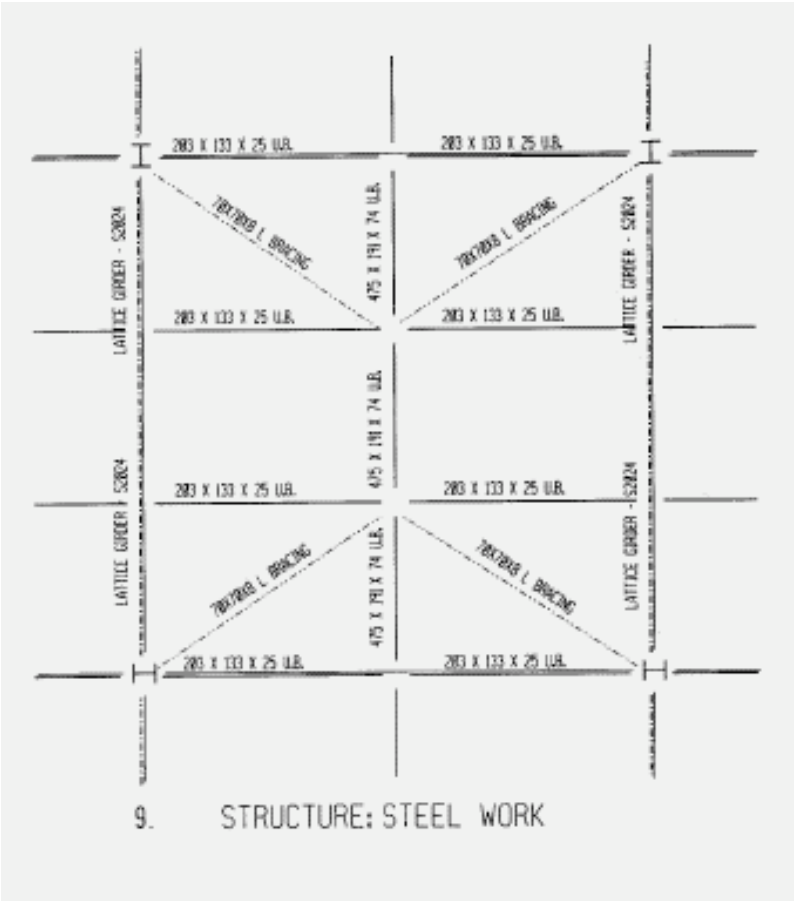
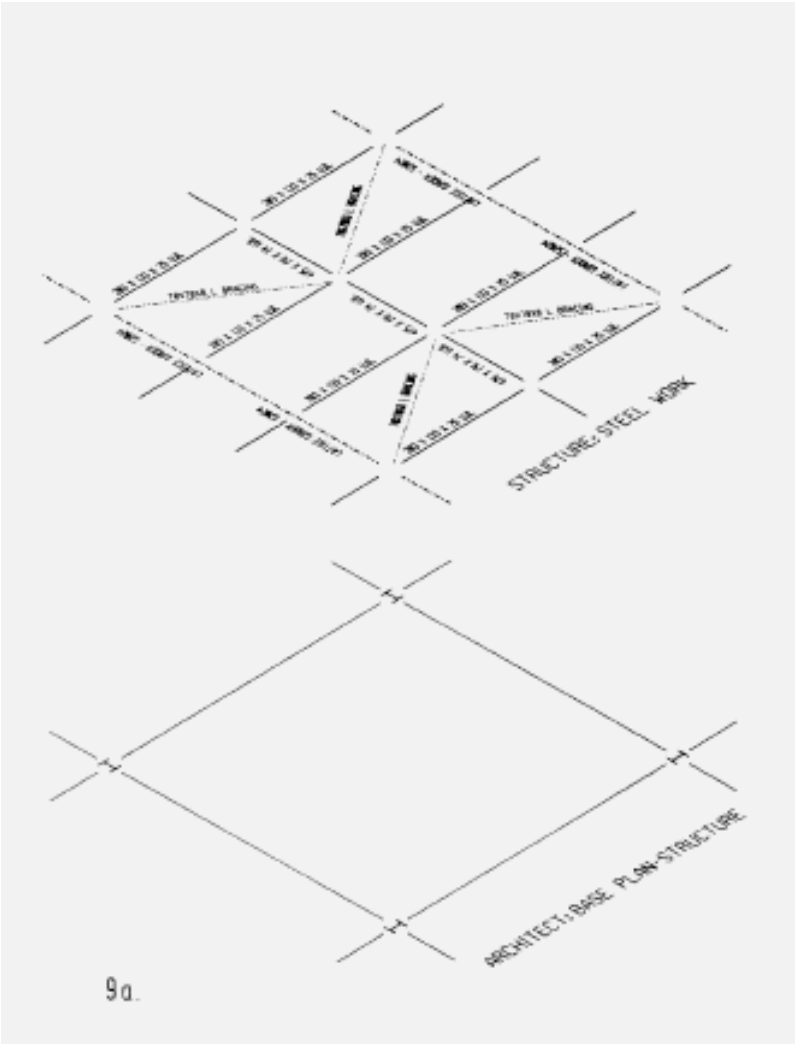
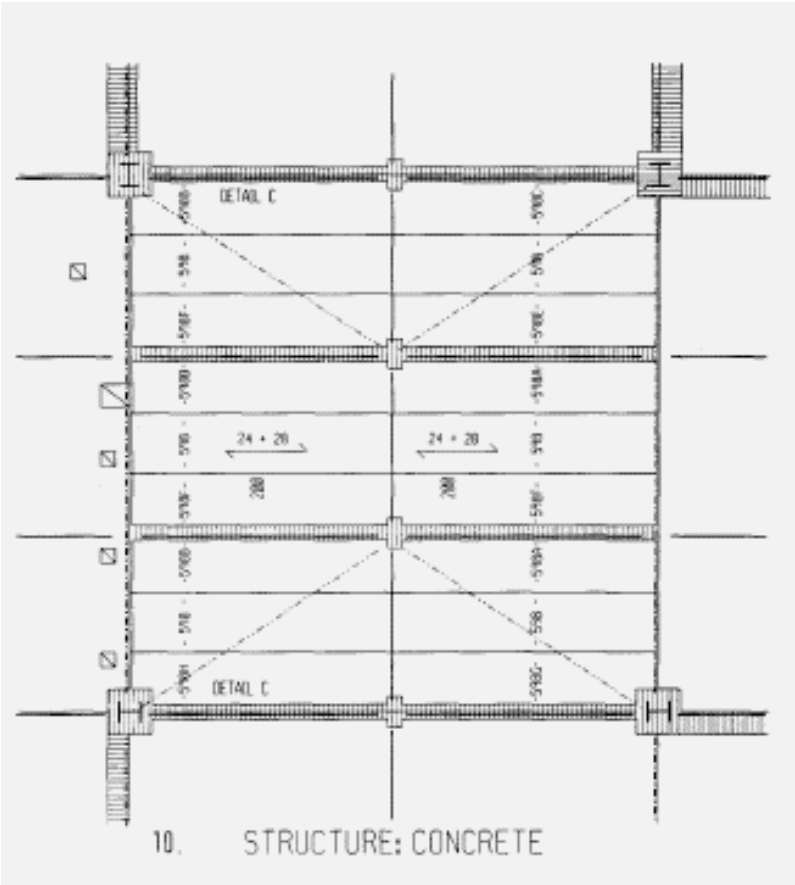
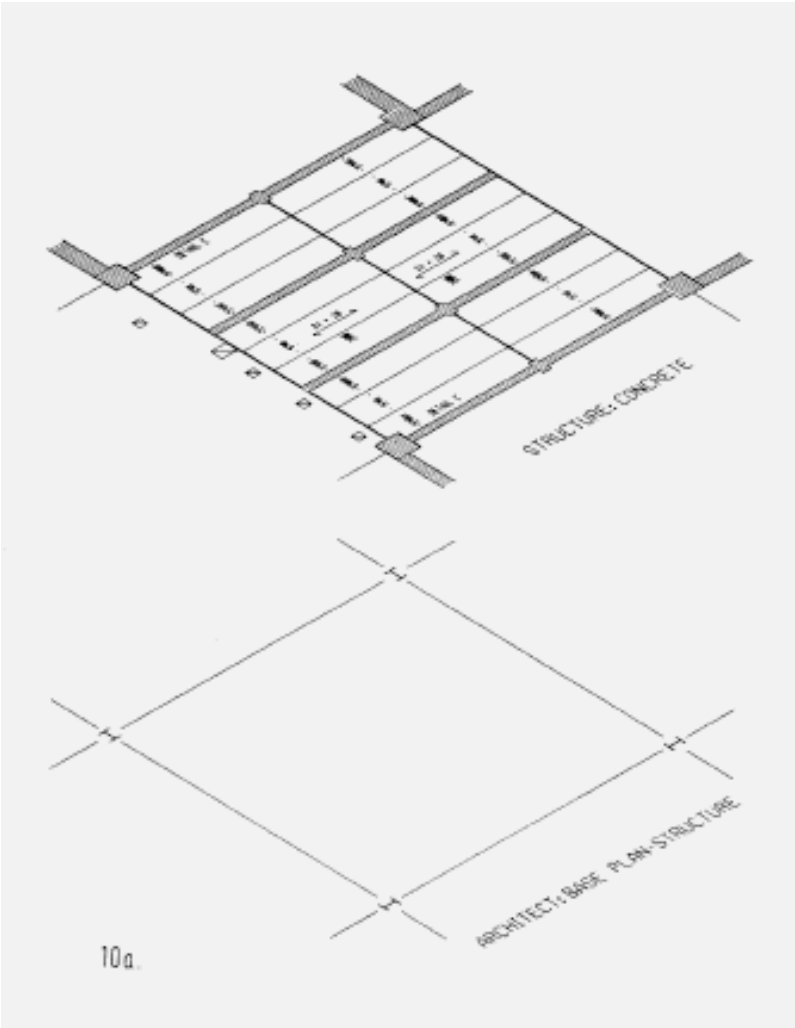


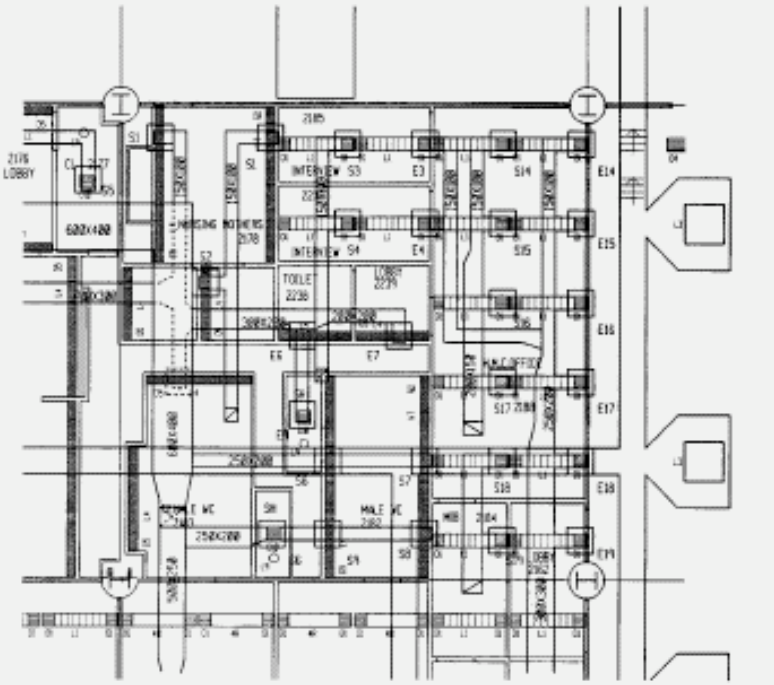
9. STRUCTURE: STEEL WORK


STRUCTURE/ STEEL WORK
ARCHITECT: BASE PLAN-STRUCTURE
9a.

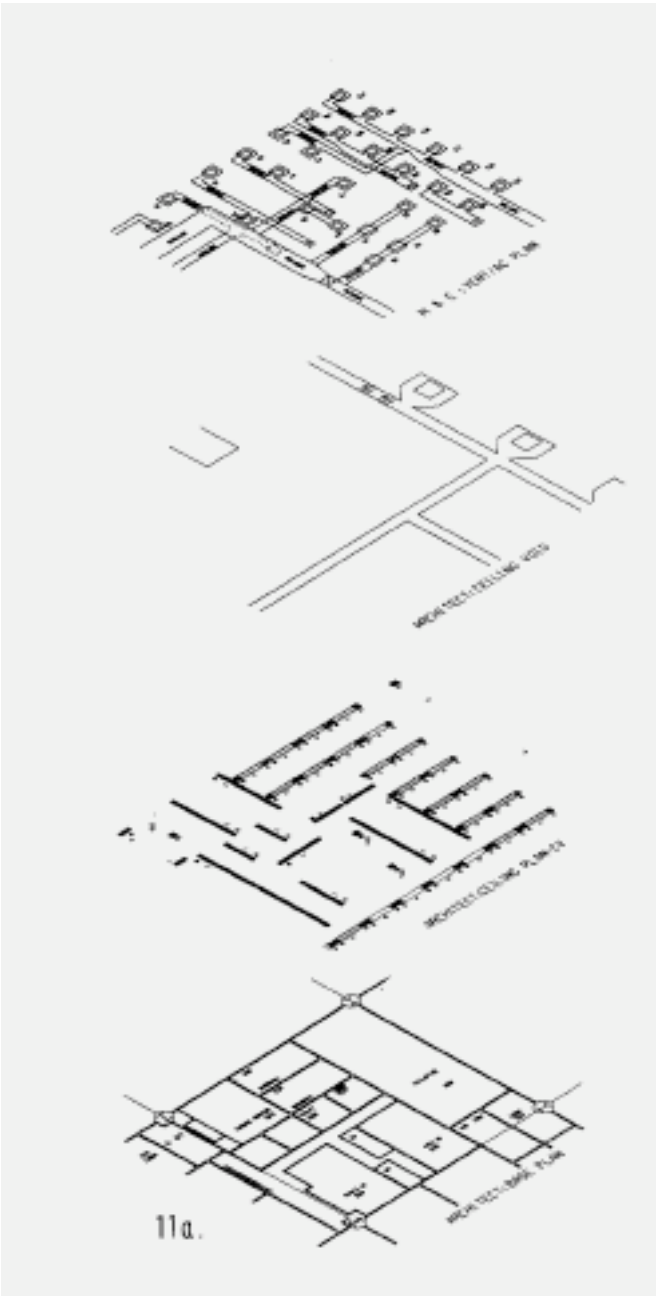


10. STRUCTURE: CONCRETE


STRUCTURE: CONCRETE
ARCHITECT: BASE PLAN-STRUCTURE
10a.



11. M & E : VENT/AC PLAN



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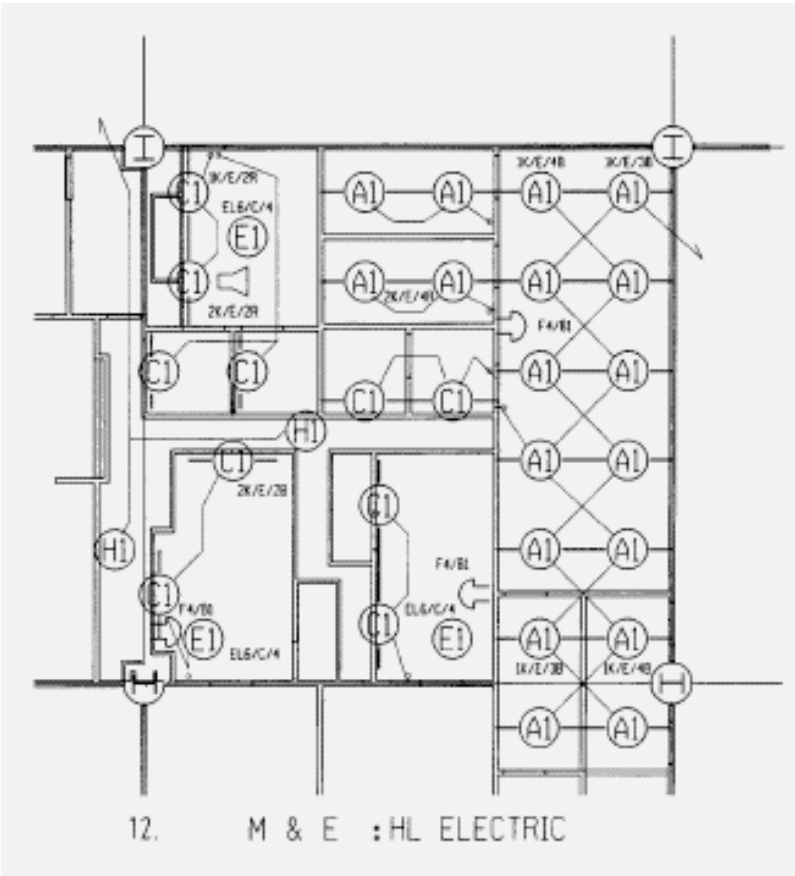
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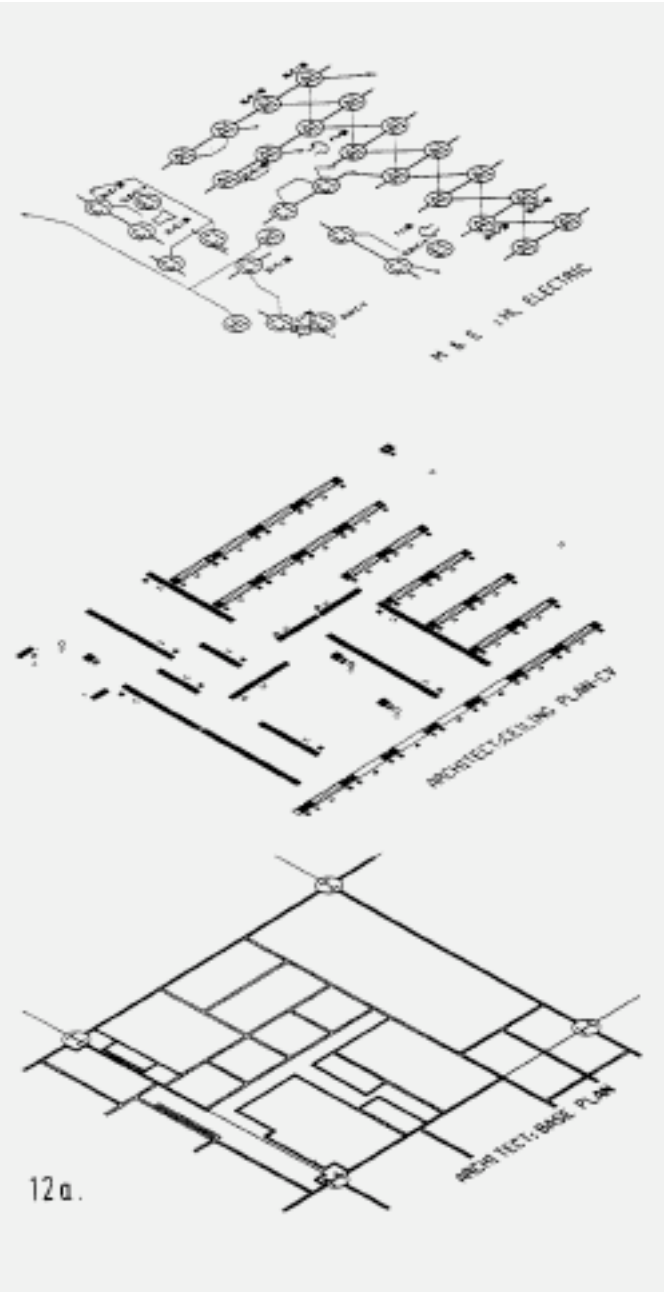
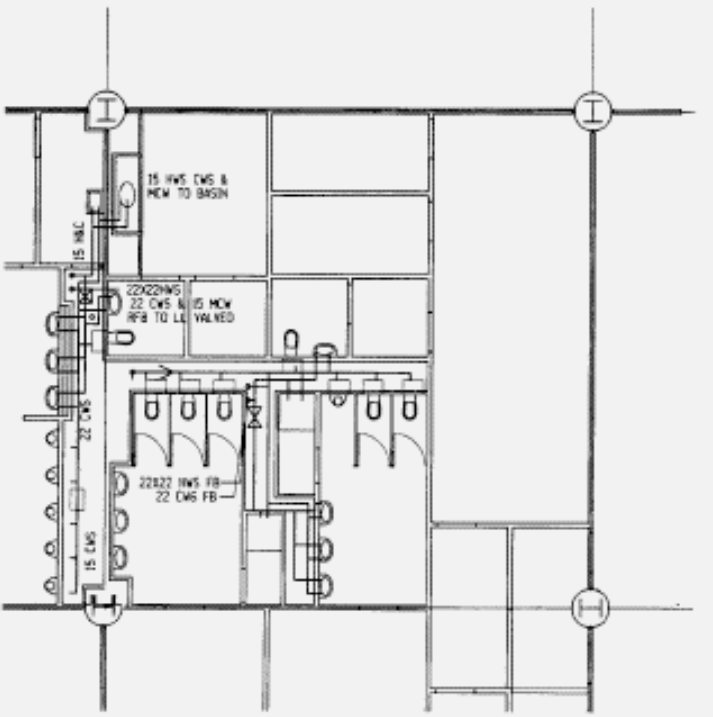
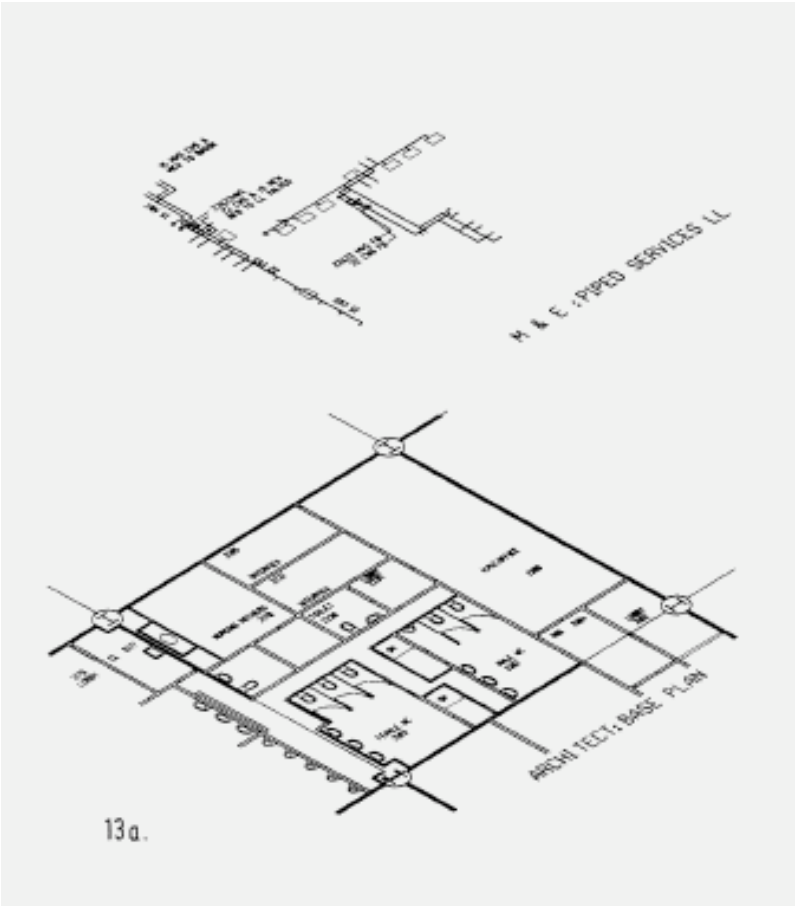
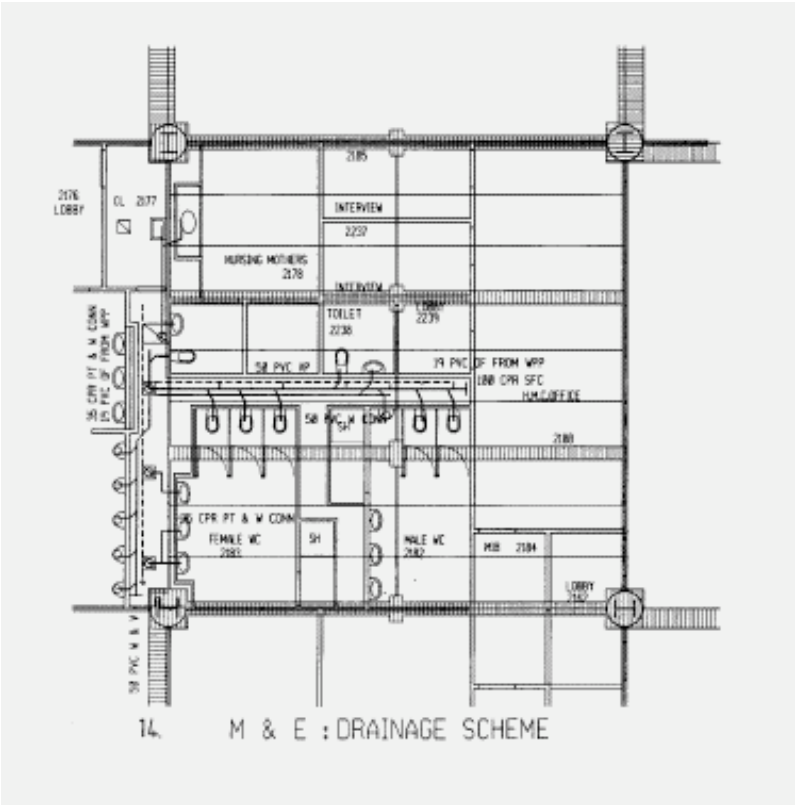

M & E : HK ELECTRIC
ARCHITECT: CEILING PLAN
ARCHITECT: BASE PLAN
12a.

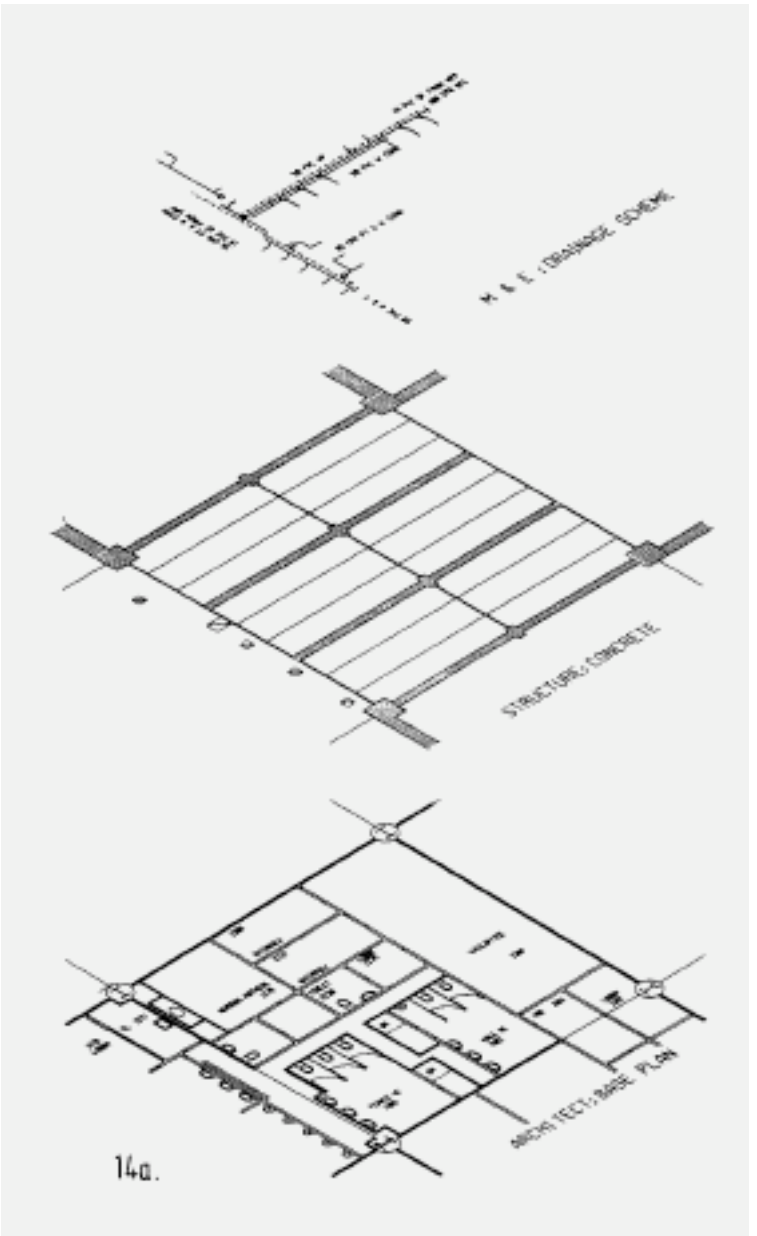


13. M & E : PIPED SERVICES LL


M & E : PIPED SERVICES LL
ARCHITECT: BASE PLAN
13a.



14. M & E : DRAINAGE SCHEME



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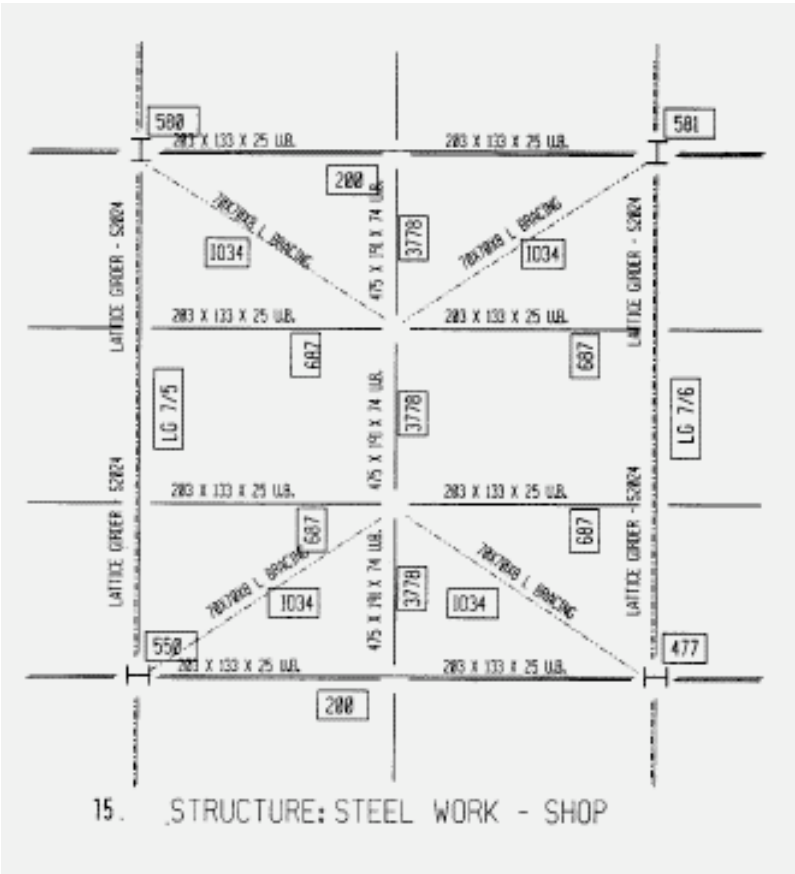
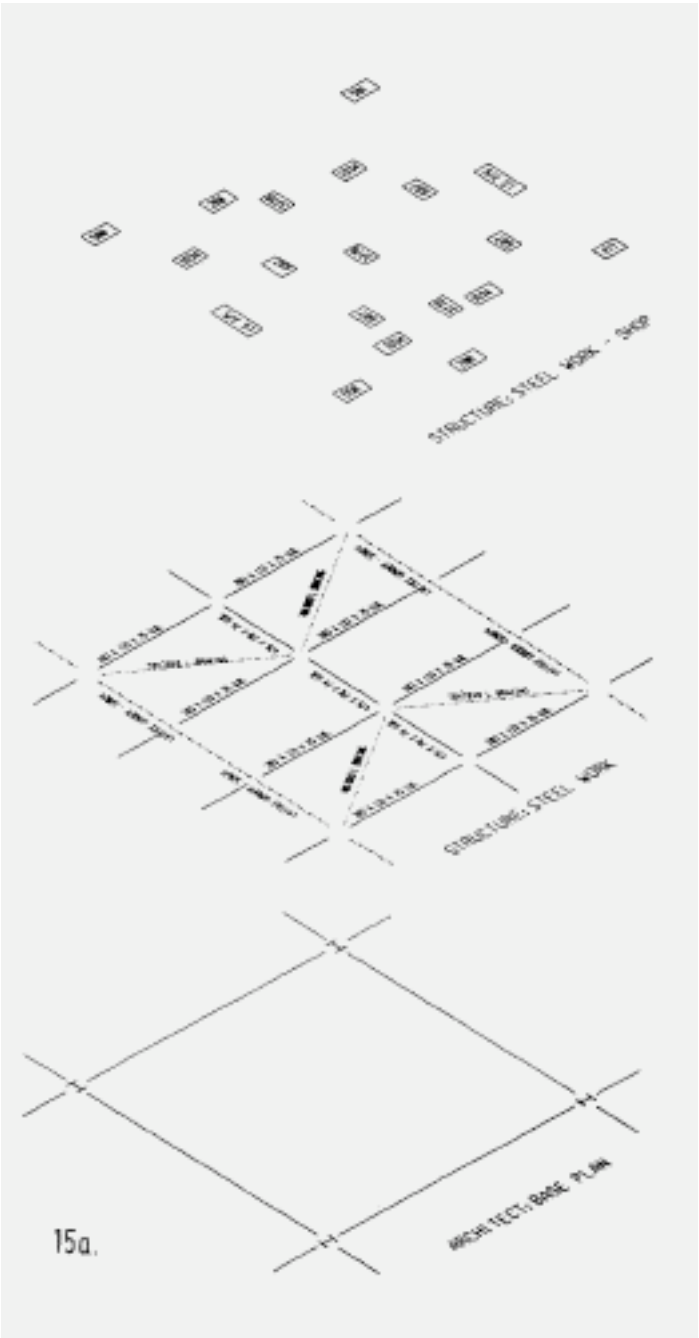


15. STRUCTURE: STEEL WORK - SHOP


STRUCTURE; STEEL WORK - SHOP
STRUCTURE; STEEL WORK
ARCHITECT; BASE PLAN
15a.