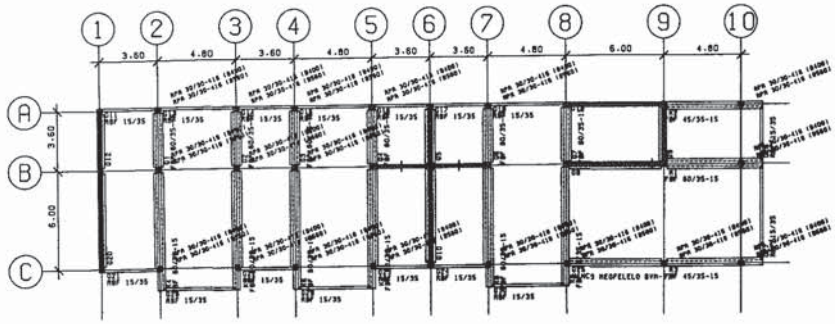
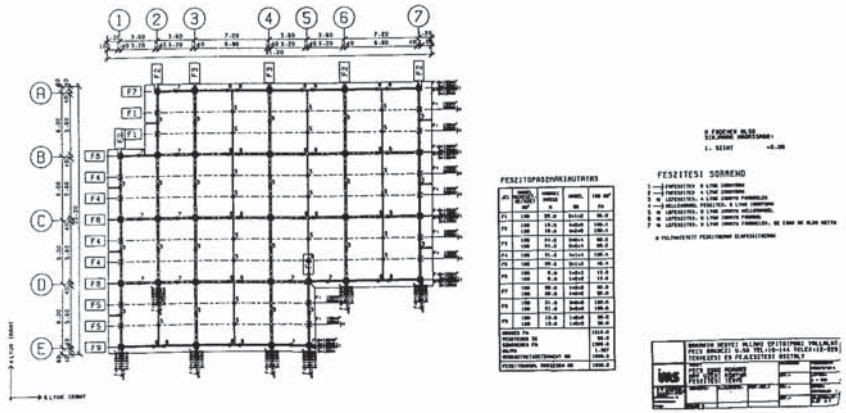


5 Plotter-traced floor slab plan of a "BVM-TIP" building



6 Plotter-traced prestressing plan of an "IMS" building



# Development of CADS and their Interactions with Other Automated Systems

Viadimir N. Maststchenko and Valentin P. Ignatov

Gosstroy of the USSR
26 Pushkin street, Moscow, 103828, USSR

KEYWORDS

Buildings, Computer-Aided Design Systems, Construction Preparing, Design Technology, Structures.

ABSTRACT

Design technology, design procedures and data sets providing synthesis, analysis, estimation, and choice of installation design were investigated to develop the computer-aided design systems ( CADS ) of structure and item catalogues and also catalogues of industrial and civil buildings. A new computer technology of design was worked out on the basis of this information and the previous design automation experience. This technology provided 2-5 times labour and time expenditure decrease, and 7-10 percent economy of material resources. Examples of information transmission from the CADS to information processing systems for construction preparing show the possibility of an important economy of time and engineer work during this work as well.

# Evolution des SAPR et leurs interactions avec d'autres systèmes automatisés

Vladimir N.Mastatchenko et Valentin P.Ignatoff

Gosstroï de L'URSS
26, rue Pouchkinskaïa, Moscou IO3828 URSS

MOTS CLEFS:

Bâtiments, construction, structures, systèmes automatisés de l'établissement des projets, technologie de l'établissement des projets.

Sommaire:

Pour la mise au point des systèmes automatisés de l'établissement des projets des ensembles des structures et des produits fabriqués, de même que des batîments industriels et d'immeubles d'habitation, il est étudié des technologies des travaux de conception et des données assurant la synthèse, l'analyse, l'estimation et le choix des solution de projet pour des objets correspondants. De nouvelles technologies de l'établissement des projets sont mises au point sur la base de ces informations et de l'expérience antérieure de l'automatisation des travaux de conception.

Ces technologies ont assuré une réduction de 2 à 5 fois de la quantité du travail et du temps nécessités par l'établissement des projets et l'économie des ressources matérielles de 7-IO%. Des exemples du transfert des information du SAPR dans des systèmes automatisés de traitement des données pour la préparation de la construction montrent la possibilité de l'économie du temps et du travail des ingénieurs pour ces opérations.



## INTRODUCTION

Automation in design and allied fields of construction activities is carryed out on a large scale. Usage of applied programs made it possible to automate a certain part of design work. Further development of computer-aided design has the trend to unite the applied design programs, input-output, dialog, graphics, data bases, and technical means into the integrated computer-aided design systems, further called CADS. These systems are efficiently used in many kinds of design work, including the design of building element system, buildings as such, and structures ( roads, bridges, waterpipes, towers, etc.), series of technological productions, making of cost estimates and registers of material resources needs, etc. The CADS use makes it possible to fulfil by the computer-aided design means 40-80% of the total design work covered with the system. The paper gives brief information on several CADS having different levels of complexity of the design problems to be solved.

## 1. CADS of Industrial Building Structure Catalogue.

The system is meant to design new , and also to correct the existing type sets (catalogues) of one- and many-storeyed industrial building structures used on the country scale, according to her regions, and for seperate massive buildings. The traditional process of the mentioned catalogues design (using applied programs) is shown on the Fig. 1. (1). Detailed studing of this process , and also the design procedures and data sets, it includes, made it possible to give an economic basis to the necessity to create a CADS catalogue for design operations, entering in the B and E blocks (see Fig. 1.). Though there are applied programs for solution of the tasks shown in the A block, and the information systems to use them in the D and E blocks, it has been found useless to include them in the CADS catalogue from both economic and systemotechnical points of view. The Fig. 2. shows the general architecture of the CADS catalogue (2). The technical means of the system: an EC computer, alphanumeric display stations, plotters. The total software on disc memory makes approximately 7 Megabytes, the data base capacity is up to 100 Megabytes. The system is fuctioning since 1982 and provides 7% reduction of building structure costs in all the volume of the use of type structure sets in comparision with the previous version of structure catalogue. Labour expenditure is 25% reduced. In case of solution of some problems, for instance, design of a set of prestressted reinforced concrete columns, the labour expenditure is 73% reduced. The labour expenditure decrease in comparision with traditional technology is due mainly to the possibility of intracomputer information

transmission between the sub-systems and their integration. In the same time expenditure for initial data input and analysis of results is reduced. In the given example the reduction made accodingly 48% and 65%.

## 2. CADS of Building Structures.

Design of frame type building structures for social or industrial (with light loads) purposes on the basis of the corresponding type structure catalogue is sort of a mass design work. The basis of the taken CADS is a developed data base including a full description of all the catalogue elements and their interactions, parameter description of prototypes of structure element design solutions to make possible individual design of the elements lacking in the catalogue, a library of erection schemes of elements, specificaton reference information and so on. The data base is maintained on a high-power EC computer controlled by the corresponding DBMS. The Fig. 3 shows the main functional sub-systems included in the system. The system contains the language of installation description and also the language of drawing description (3). The technical means complex includes a central high-power EC computer,and the related automated work places (AWP) for designers on the basis of CM computers with alphanumeric and graphic displays. For mass production of drawing documents the EC serial plotters operate off-line. The system is functioning in experimental operating mode since 1975 , and in idustrial mode since 1980. It made it possible to shorten 10-15 times the design terms of the mentioned buildings, and to provide a 10-15% economy of load-carring structure materials. This CADS has also helped to design the type structure catalogue,that is the basis of its work.

## 3. CADS of Industrial Buildings.

Development of methodology and accumulation of experience of CADS creation made it possible to set a task of development of a CADS of industrial buildings as a complex technical system consisting of functionally different , but mutually linked parts - structures, heating system, ventil a tion, air-condition, water-supply and sewerage, electrotechnical devices. A CADS of this type is an equivalent of integration of several CADS of the above-described kind in one system. The system is based on a multi-computer complex consisting of an EC computer and automated work places (AWP) (2). The independent use of sub-systems is envisaged.



## 4. Complex CADS of Design Organization.

Integration of CADS increases the volume of work and terms of development, requires a unified model of the installation massive work to organize data bases and construction of corresponding languages for CADS, both external and internal. That is why in many cases the integrated automation in design organizations is provided by the way of creating automated design technology on the basis of several CADS of the types described in the p.p. 1,2, and applied program packs. One of the examples of such a complex system is described in (4).

## 5. Interactions of CADS with Other Systems.

There is experience of cost estimate and material need registers transmission from the CADS to the computer centres of construction organizations on magnetic mediums. In the same time from centrelized data banks information is delivered on magnetic mediums to the CADS. It concerns catalogues of structures, materials, common standards and estimations for construction etc. Further development of this work requires systemotechnical unification and integration of information in design and construction. This is a worth-while trend of work for the near period.

## REFERENCES

1. V.M.Maststchenko, J.G.Mirvis, V.N.Ukolov "Automation of building structure design," Stroyizdat,Moscow,1982,p.224

2. D.A.Avetisian, V.P.Ignatov, G.D.Frolov, G.J.Epeltzvaig, "Automation of construction and technical installation design", Nauka (1985),Moscow, p.135

3. L.G.Dmitriev, A.V.Krasilov,G.V.Gilman,V.P.Kovbasuk, "Computer-aided design of civil building structures", Budivelnik,Kiev (1977)

4. Journal "Design and Engineering Research", 6,(1984)

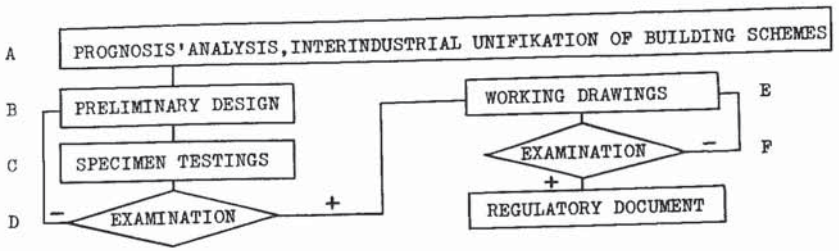



Fig.1. General scheme of structure catalogue design

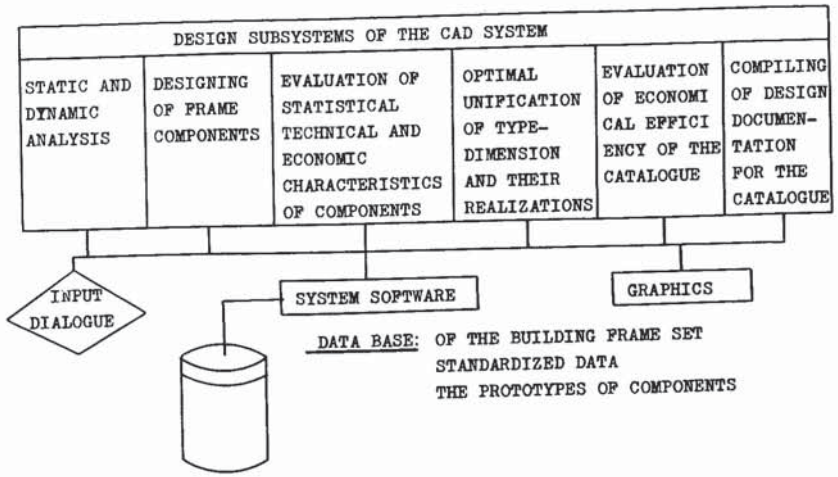



Fig.2. Main components of catalogue CADS



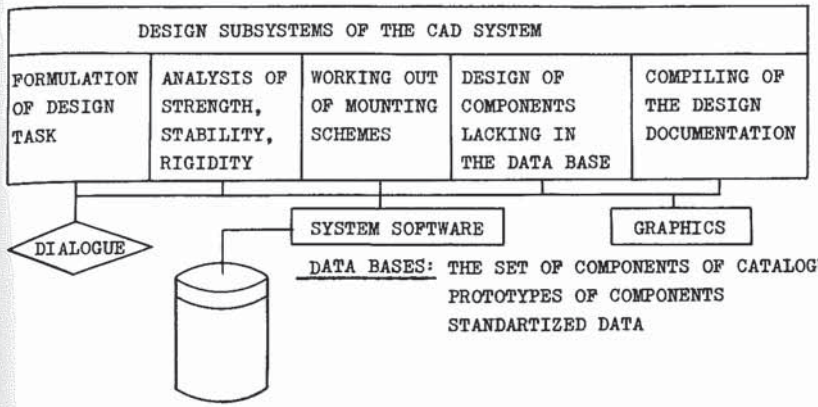



Fig.3. Main components building structure CADS