EAEA conference abstracts 1997

FINLAND
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Developing a new endoscopy laboratory with digital tools

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Abstract
Tampere School of Architecture had to leave its old down-town building and move to the TU Tampere university campus in Hervanta, 10 km away. In this process, the 20 years old endoscopic system "The Urban Simulator" was one of the victims. Old mechanical parts and especially the original home-built microcomputer system were too old to compete with modern computer-aided methods.

A new endoscopical system is now under construction, using all of the 20-year experience, new technical components and computers for camera control and picture processing. Real-material modelling is used together with computer-aided planning and visualization methods taking the best from both sides.

Developing a new endoscopy laboratory with digital tools

The School
The Department of Architecture in TU Tampere is a quite small educational unit taking only 35 new students each year. These students are chosen in very strict national tests together with the two other architectural schools in Finland: Helsinki University of Technology / Department of Architecture (HUT) in Otaniemi/Espoo and University of Oulu / Department of Architecture. After a quite long study time (median 9 years) over 90% of students are graduating. The school has a good international reputation based on numerous prizes in international competitions for architectural students (recent list on the web-site).

The Department of Architecture was for 20 years situated in an old down-town factory building. This building is owned by a private company and the rental rates are following those of the neighborhood. In recent years, the center-point of the town has moved to these quarters raising the value of all commercial space.

The strict money policy of the finnish government led in october 1995 to an order to move the whole 4000 sqm educational unit to the university main campus in the satellite-town of Hervanta. This led to the total re-valuation and re-planning of all the technical equipment and laboratory units of the department.

The old training system
Our old working methods were based on hand-made architectural presentation posters. Most of the material was made with half-technical methods photocopying separate fragments to the size needed for final artwork.

Photographs, computer renderings, video prints and grabbed video frames were commonly converted to paper halftones before the photocopying process. Flatbed and slide scanner were used only on limited numbers of professional projects. Videotapes and computer animations were used only for some specific projects.

The endoscope system and the video editing were linked together and separated from other picture processing services. For space-economical reasons, the photography studio and art teachers were using the same studio rooms (only one day / week for art teachers).

[see 05p01.TIF]

Early system "Urban Simulator"
Tampere School of Architecture has been using endoscopical model photography systems since 1978. The main tool has been a computer controlled camera rig, "The Urban Simulator" with its video output to a video recorder or a grayscale video printer.

In recent years, however, the endoscopical photography has been considered an effective alternative to other photographic and computer presentation methods. Main reasons in choosing a proper tool for a specific project have been the picture quality and output format, time schedule and process speed, amount of picture material needed and the number and skills of the persons willing to proceed the project.

The new building

The new location of the department of architecture is a 12 years old university building used originally by the Department of Civil Engineering. The wings were built for office and seminar rooms. Only minor wall and electrical modifications were needed, where space was used for basic teaching or research. Most of our old furniture was moved to the new building and rebuilt or repaired for interiors.

The building grid is 6 by 6 meters. For lecture rooms 12 meter span beams are used in one direction. Small lecture rooms are arranged in pairs using 2 by 3 grid units. Light walls are built of gypsonite board, which makes room modifications quite easy. Lecture room height is 3.5 meters, which is enough for normal 3 m studio light statives (Manfrotto # 231). Office rooms are 3 meters high.

The auditoriums and laboratory rooms needed a total rebuilding in order to be suitable for the technical and audiovisual level maintained already in our old building (originally these laboratory rooms were used as water and concrete laboratories). New technical equipment and especially the need for sound-isolated recording space added some aspects to the list of modifications.

Laboratory spaces are reserved for a computer class, a photographic studio, traditional photographic laboratories, digital page and poster layout, video editing and presentation, and a model workshop.

Computer class is big enough for teaching an entire class and also has a separated space for printers and network connection units. All technical units are located very close to each other and the staff rooms.

All students have alltime access to the computer classes and to the photography laboratory. Doors are controlled by personal access cards and number codes.

[Picture 05p02.TIF]

Aims for the new system

The new architectural media laboratory AML is offering all students a possibility to do a complete project in digital format. Final work can be printed out or presented in digital format from a computer screen or a data projector.

The laboratory controls all presentation systems in the department of architecture. Some page layout computers and printers are located in the faculty wings, but the entire system is maintained by the laboratory.

The capacity of this system is big enough for all current publication projects. More server and printing capacity is needed, when all students and teachers are ready for digital working methods.

Computer network and workstations

All operational units of the original computer network were removed with the earlier laboratories. The only remaining part was a built-in thin-ethernet cable connecting the staff rooms. We had a free field to choose an effective solution.

A new network connection center was built next to our computer classroom. This place gave

us best possibilities to connect our laboratories and staff rooms to the university network. Future connection to the faculty wings was prepared by building connection frames ready for extra cables.

The new cabling solution was a CAT-5 twisted-pair star network. Currently we are using mostly 10base network adapters. Some of our connection units are ready for the future 100 Mb information transfer rate. This should be enough for transferring moderate-quality compressed video in real time.
A new basic level computer system has a 17" screen with 4 Mb display and 64 Mb system memory. Both Mac and WinNT operating systems are used. For everyday use all computers have a software package consisting of Microsoft Office, Adobe PhotoShop and Adobe PageMaker.

"Total digital control of architectural presentation", the basic schedule
The space reserved for PC workstations in the new building is big enough for teaching an entire class (15 machines / 30 seats). Data projection on a 100" screen is used for teaching the programs. A separate room with 5 workplaces is reserved for page layout and picture processing (Mac/20" screens). All staff rooms are equipped with computers and network connections.

All new computers are equipped with large-capacity hard disks and removable disks. This is the only solution for the high disk capacity needed for full-color photographs, CAD renderings, publications and posters. A good quality scanning of a photograph can produce a 18 Mb file and a poster artwork can be over 50 MB! It is impossible to maintain system disks big enough for all of our 200 active students and 50 teachers. With all important files on personal disks, there is no need for safety copies from system disks.

Our basic recommendation is a 100 Mb Iomega Zip drive. The Zip removable media is formatted either for Mac or PC, but Macs can read and write on PC-formatted disks. For greater flexibility and compatibility with the outside world SyQuest (88 Mb), Iomega Jaz (1 Gb), Panasonic PD (640 Mb) and Imation A-drives (120 Mb) are assembled to some computers.

"Computer-aided architectural presentation"
Computer-aided presentation is a combination of imaging, layout and output. One set of original material can easily be shared and modified for different output formats, if the basic work has been done in a correct way.

Images can be produced by computer (rendering and painting programs) or with image capture systems (digital photography, scanning and video captures). Combinations of different picture materials are possible. Video and multimedia formats can use sound capture or computer-created soundtracks.

Project layout is done inside the computer (poster layout, page editing, www pages, multimedia production or video editing). All these formats can use computer effects and automatic digital tools.

Output format is chosen for a suitable final product (saving to a presentation or printing file format, printing, CD production or video recording). Large format ink-jet printers are used for traditional poster presentation.

If the original material is shared through a computer network, it can be constantly updated. There are no problems with out-dated information material. New digital presentation formats make sharing and paper output by the user easy and practical. Adobe Acrobat .PDF-files for printed pages and the new FlashPix for large picture files are the best tools for sharing pictorial material. (FlashPix is now on beta level and has at the moment only Win NT support, see http://www.photo.net/photo/ or http://image.hp.com)

Final presentation can be done directly on a computer screen or through other presentation methods. Data projection systems and a high-capacity computer network can transmit information to large auditoriums in different places.

The computers for input material
A lot of drawings and picture material is produced by CAD programs. We are using ArchiCad, AutoCad, AutoVision and 3D Studio Max. Good-quality light simulation is achieved through importing 3D files into Lightscape for final rendering. For simple 3D modelling and virtual reality we have Virtus Walkthrough. All these programs are installed in our computer class.

The input of picture material is done mainly in the page layout studio room. Both flatbed and slide scanners are used. All scanners can work with a 24-bit color depth (30-bit color with HP ScanJet 4C). In house, we can scan 35 mm slides in resolutions of up to 2700 dpi. This is practical for an instant need, but quite a slow process. Larger amounts of photographic material are transferred to Photo CD disks by a local professional laboratory.

Video grabbers are used in the photographic studio and in the video editing room. Truevision video cards can use 16-bit and 24-bit color depths for .TGA (Targa) files. Some other grabber cards use .BMP or .TIF file formats. The picture file can be a square pixel 768 x 576 map for picture processing or a smaller rectangular pixel map for video editing (740 x 576 for ATVista/RGB or 512 x 576 for Targa+/S-VHS). These rectangular pixel maps can be used for picture processing after resampling the horisontal resolution to a full 768 pixels.

In the near future, we are starting to use direct digital picture material. We are planning to use still cameras and digital video. The transfer from camera memory to the computer is done through a direct cable contact (SCSI or a special connection). A docking port for a PCMCIA memory card is possible with some camera models.

Computer stations for image grabbing and basic processing are ready. These computers are built in 19" boxes and assembled in rack frames together with all other electronic equipment needed for a specific part of the process. This kind of a presentation system or a workstation is easily transportable with all of its accessories and can be used as a part of the picture taking process.

The computers for presentation artwork
A group of 5 Macintosh PowerPC computers is used for page layout projects. Large 20" trinitron displays and 64 Mb memory capacity make truecolor work possible. Adobe PhotoShop, PageMaker and Freehand Graphics Studio software are used for most of the projects. The project files are saved on the network disk or on removable disks.

An easy and good-quality perspective correction of architectural and endoscopical

photographs is possible in PhotoShop. Round endoscopic pictures can easily be framed and enlarged. A very wide picture angle and a clean framing is possible, when some picture information is added to the black picture corners with the rubber stamp tool.

There are laserprinters for b&w documents in formats A4/A3 and color printers for A4 and roll material (max width 900 mm). All printes are PostScript capable.

The computers and recorders for video and audio
The video material can be edited in digital (AVI or MPEG) or analog (S-VHS) format. Computers are used for audio, graphics and titling even in analog video editing.

A special computer system with big disk capacity was built for semi-professional digital video editing (Fast AV-Master video card). Medium-capacity removable disks: Imation A-drive (120 Mb), Iomega Zip (100 Mb) and Iomega Jaz (1 Gb) and a CD-recorder add capacity for short video projects. The ready-made video file can be printed back to a videotape or used on the internet or for CD-recording.
The sound-isolated video editing space is now operational, but not finished. We plan to build a new rack and table system for the equipment. The small sound recording and av-presentation room is ready for use. There are 5 seats, CDi, S-VHS and computer presentation equipment and a Dolby ProLogic sound system.

[picture: 05p03.TIF]

“The Urban Simulator II”, the studio and the systems plans

The studio
The new photographic studio is equipped for both photographic and video work. Collecting and rebuilding all old lighting and supporting tools gave us a practical toolset for a professional studio. Only some minor updates were needed.

The studio ceiling was rigged with a 50 mm tube grid (1 by 1 meter square) and an Erco 3-phase power supply system. A maximum power consumption of 30 kW was estimated. An air-conditioning system was built for keeping the room temperature on a normal level.

Manfrotto Expan (# 046) studio background system is used for photographic work. Hanging hooks for background paper rolls are fixed on the studio walls. A Manfrotto Autopole2/ SuperClamp support system (# 432-3.7 / # 035) can be used outside the normal background and light support points.

The studio space is big enough for 2-3 student photographers to work at the same time (82 m²). All surfaces are painted black for killing straylight (Rosco Supersaturated Velour Black # 6003). This makes it necessary to build all light, because the wall reflections in a big black room are minimal.

The studio is equipped with a 3-channel speaker system and a 3 m wide screen. The space can be changed quickly to a multimedia lecture room (50 seats).

The light system
Our old Redhead/Bluehead (800/2000W) halogen light system is used in the new studio. The system can be used for all photography and video projects. Nearly the same color

temperature with good color reproducing quality is chosen for the fluorescent tubes (Osram/32 or Philips /930, 3000 K, Ra=95). For working space and secondary use we have a set of halogen workshop lights equipped with barndoors (Frame Tools/Finland).

The new endoscope optic has a bigger aperture than our older systems. Only a fraction of our old lighting level is needed. This makes it possible to easily create good simulations of real sky and light situations.

The sky background system presented in the second EAEA conference is used for architectural model photography. We have some 20 different cloud pattern gobos for the cloud projector and a cyclorama light set for the blue sky. For interior models, a Lastolite diffuse tent with 3-4 halogen spotlights is used for soft shadowless light.

For photography, Ektachrome 64 T tungsten film with good reciprocity characteristics is still used. The automatic Olympus SC-35 endoscopic camera is capable of time exposures up to several minutes.

The new automatic video camera has a good basic sensitivity. With automatic gain, a minimum illumination of 1 lux on the target surface can be used.

The endoscope
An Olympus Modelscope M 100-033-090-80 wide-angle endoscope is used (80°). This optic is free of optical deformations and has a very even light distribution. Aspherical elements and multicoated lens surfaces are the solutions for a good optical performance.

The focusing is done by an ocular adjustment ring. The endoscope is connected to the camera with an adapter from the same manufacturer. For video, a full screen picture is achieved. The photographic adapter uses most of the round picture clipping only small parts of the picture top and bottom.

The photographic system
A full-automatic Olympus SC-35 endoscope camera is used for student projects and other every-day works. The camera body has a manual exposure correction (±3 steps in _ step intervals) and exposure speed override.

For special projects, a Nikon body with a motor drive and a data back can be used. Both systems have bright aerial-image viewfinders. Focusing is done by using the central hair-cross of the viewfinder. The disadvantage of this viewfinder is the lack of depth-of-field information.

Olympus AK-1M optical adapters with suitable bayonet ends are used for connecting the endoscope to the camera body. The adapter has a round 32 mm quick-coupling for the endoscope. There are no optical controls in the adapter. The full width of the round picture is visible (Ø32 mm). Some parts of the picture are framed from top and bottom.

The Nikon system is used in all of our photographic tasks. We have nearly all components of the macro photography system, PC-optics and a wide selection of lenses from wide-angle to medium telephoto. For maximum picture quality, we use only fixed focal lengths.

The video system

An automatic surveillance camera is used for student projects (JVC TK-C1380). The camera has composite and Y/C-video outputs. Camera resolution is on the level of S-VHS recordings (440.000 active pixels). The camera functions and output parameters can be adjusted by an on-screen menu.

The endoscope is connected to the camera with an Olympus AK2-10C optical C-mount adapter. This combination gives a full-screen video picture (½" CCD in the camera).

This camera is used for both frame grabbing and video recordings.

The camera rig

For normal photography and video grabbing we still use studio statives. The endoscope is fixed to the stative arm with a conical adapter slipped around the ocular end which is formed for this purpose.

The stative is equipped with a cordless keyboard and a trackball. This makes it possible to control video grabbing, digital photography and the basic computer controls from a distant 800 x 600 resolution 20" computer screen.

The new simulator frame is planned to fill one building grid frame. This means maximum dimensions of 5.4 by 5.4 meters and a frame height of 3 meters. Travel distances of nearly 5 meters are possible. The used model space is selected by using curtains on different circular tracks. With the maximum model space, a narrow sidewalk and the other grid frame are reserved for control and workspace.

The camera wagons are driven by stepping motors and are running on linear ball-bearings. The drive system is controlled by a computer and operated by a direct hand control or by a computer program.

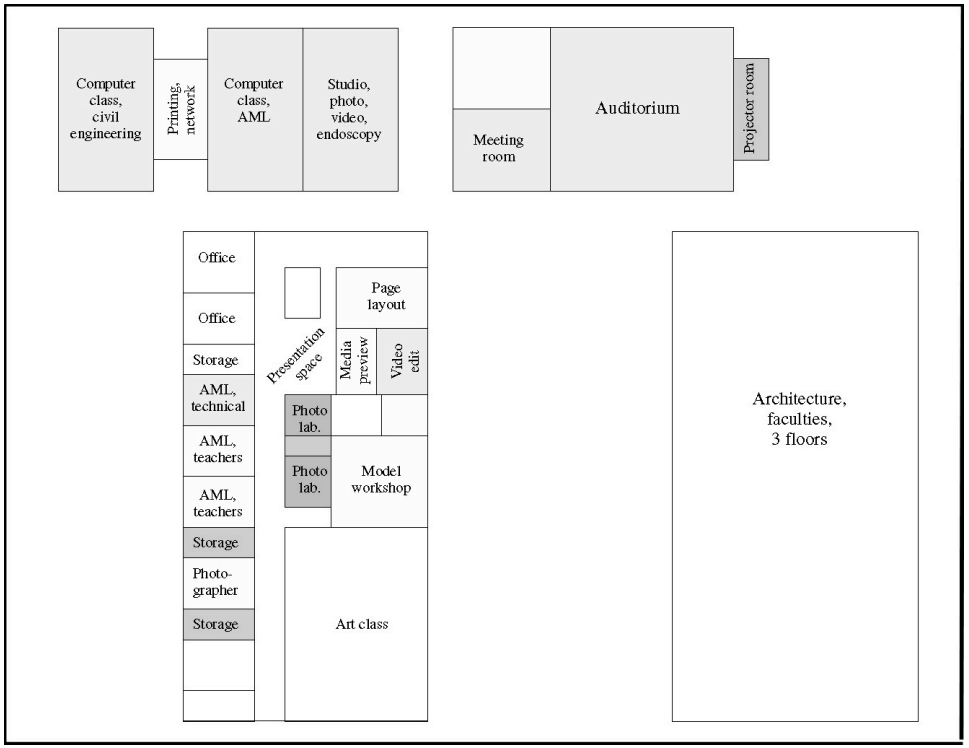
The rig is used for both photography and video. An extra vertical and horisontal arm system converts the camera head from the video column to an "upside-down" studio stative. The arm system is rigid enough for a large-format view camera (Toyo 4" x 5").

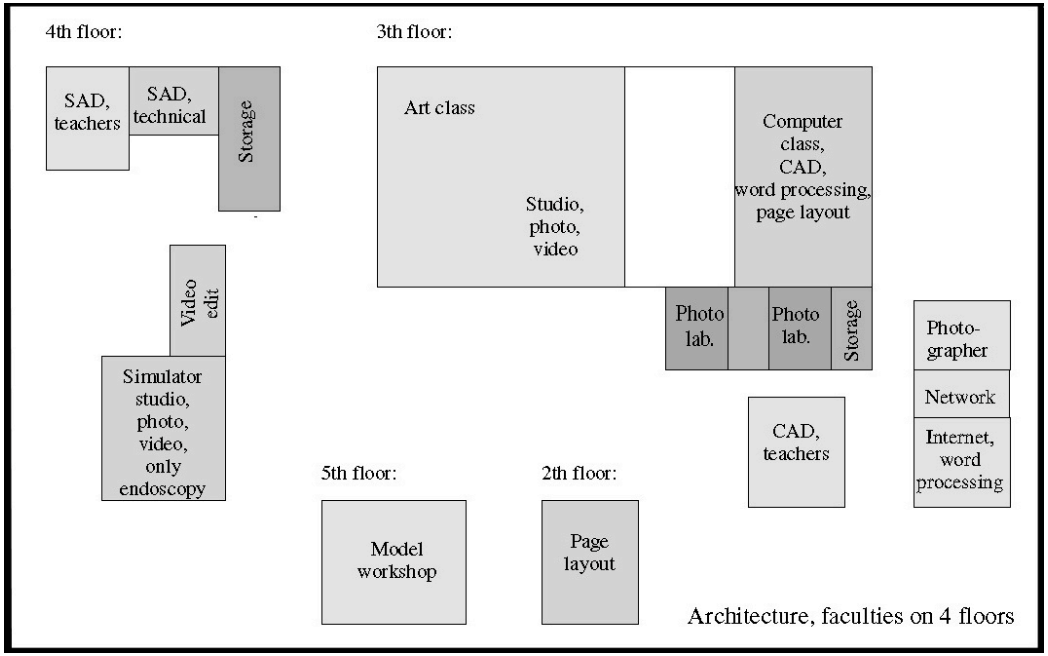
Conclusions

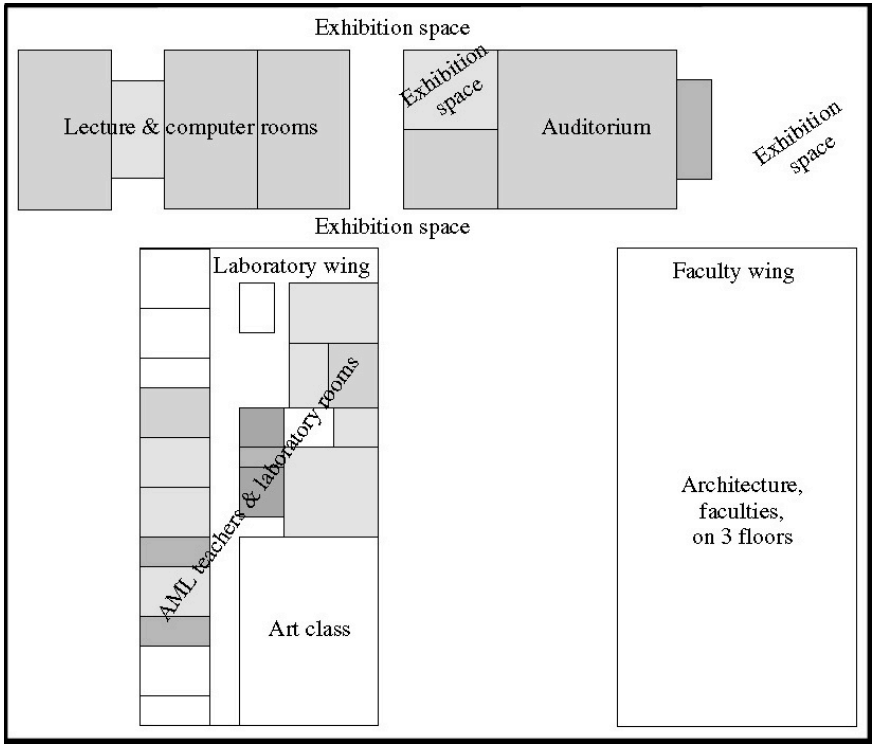
Building the total modern laboratory and computer system for an architectural school is a hard and time-consuming task (even in a small school like TUT). The new computer system has been built in winter 96/97 and it is now fully operational. The new page layout system has a constantly increasing number of users. We are going to have problems with the printing capacity in the next season. The new studio is almost completed and has been used for all kinds of photographic tasks. The first test and calibrating shots with the new endoscope system are very promising. The next interesting, but complicated task is the construction work of the computer-controlled camera rig for endoscopy and other photographic purposes.

References

TU Tampere	Web-site: http://www.tut.fi/units/arc/
Photonet	Web-site: http://www.photo.net/photo/
HP Imaging	Web-site: http://image.hp.com


Computer class, civil engineering
Printing, network
Computer class, AML
Studio, photo, video, endoscopy
Meeting room
Auditorium
Projector room
Office
Office
Storage
AML, technical
AML, teachers
AML, teachers
Storage
Photo-grapher
Storage
Presentation space
Page layout
Media preview
Video edit
Photo lab.
Photo lab.
Model workshop
Art class
Architecture, faculties, 3 floors


4th floor:
SAD, teachers
SAD, technical
Storage
Video edit
Simulator studio, photo, video, only endoscopy
3th floor:
Art class
Studio, photo, video
Computer class, CAD, word processing, page layout
Photo lab.
Photo lab.
Storage
CAD, teachers
Photo-grapher
Network
Internet, word processing
5th floor:
Model workshop
2th floor:
Page layout
Architecture, faculties on 4 floors


Exhibition space
Lecture & computer rooms
Exhibition space
Auditorium
Exhibition space
Exhibition space
Laboratory wing
AML teachers & laboratory rooms
Art class
Faculty wing
Architecture, faculties, on 3 floors