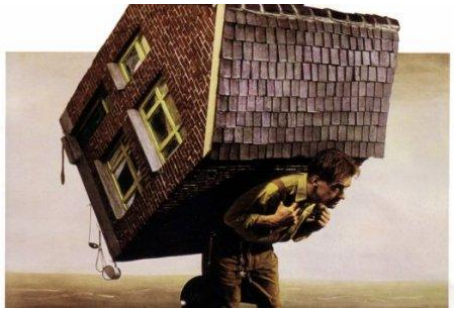
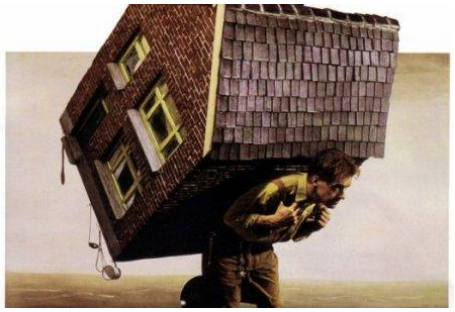
**INAR 413 BUILDING ECONOMICS**
**LECTURE 06**
**THE FUTURE PERFORMANCE OF BUILDINGS, COST-IN-USE, LIFE CYCLE COST**

- Architects traditionally have been concerned with correctly estimating and controlling the initial cost of buildings. 'However, the initial cost represents only a fraction of the long-term costs associated with owning and operating a building over its life span.
- In recent years, more attention has been paid to life cycle cost analysis, especially since the energy crises of the 1970s and 1980s. Energy costs do play a major role in the long-term costs-in-use, but they are only one of many cost factors that must be considered and understood if the architect is to make meaningful design decisions.
- Of course, both initial and future costs must be weighed against the benefits of the building: are they worth the costs? The benefits are expected to occur in the future; even if the building is sold immediately after completion, there is a delay between the initial investment and the accrual of benefits that must be taken into account.

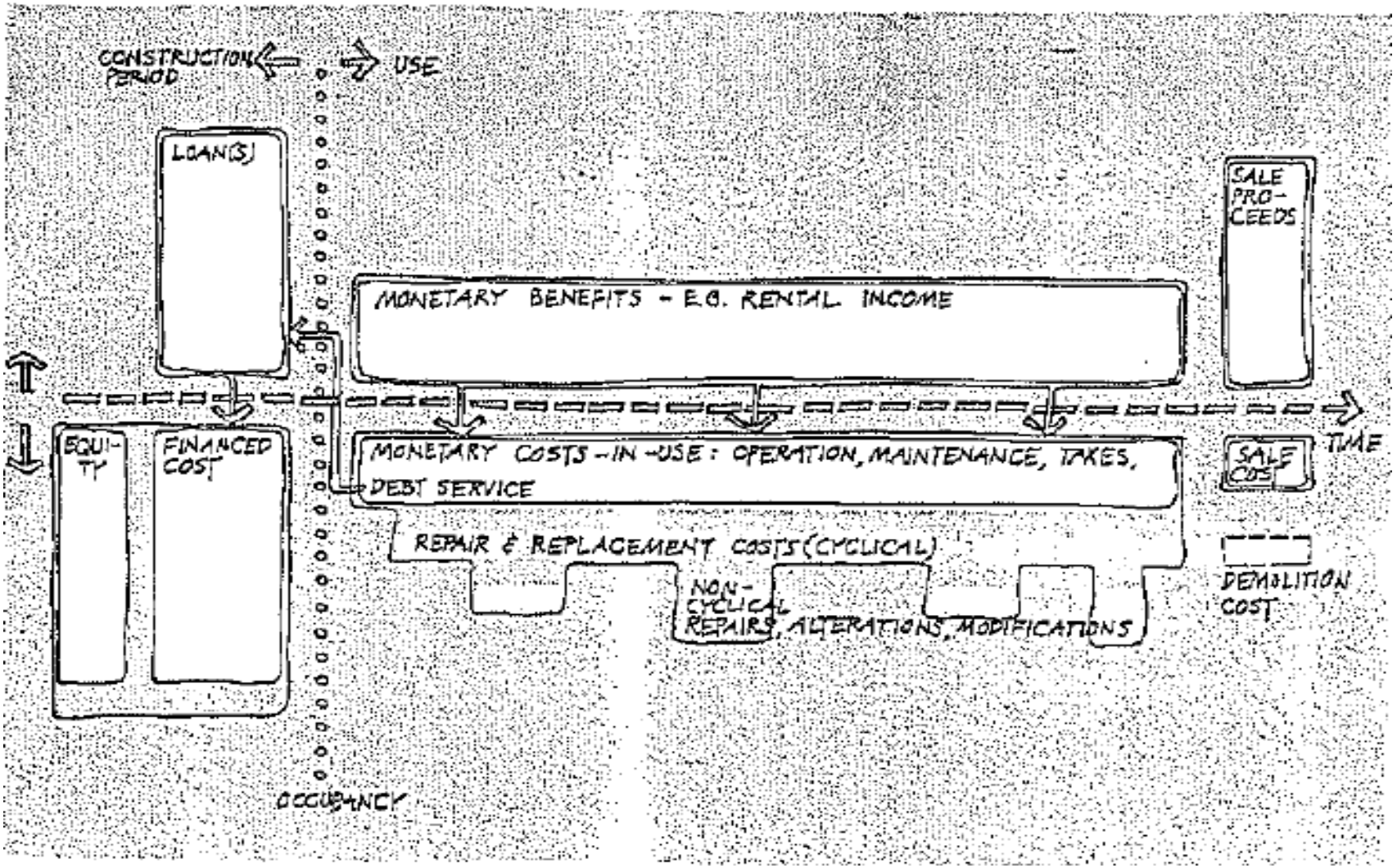


**INAR 413 BUILDING ECONOMICS**
**LECTURE 06**
**THE FUTURE PERFORMANCE OF BUILDINGS, COST-IN-USE, LIFE CYCLE COST**

- First, we must gain an understanding of what costs and benefits items will occur in the long run, and how they relate to one another. Typical main categories of monetary costs and benefits are: **initial cost, construction loan, mortgage loan, rental income and sale proceeds, debt service, operating expenses, maintenance, repair and replacement costs, taxes, and sale cost.**
- There are also **nonmonetary benefits** or use values for which people are willing to pay the rent or purchase price of a building. Additionally, there are intangible costs and disbenefits associated with the building project, such as the loss of vegetation on the site, traffic increase resulting in increased pollution, noise, runoff effects, and changes in image and quality of the neighborhood that may be caused or accelerated by the project (which may be both positive and negative, to be sure, and also may be regarded as positive or negative by different parties affected by the change).

**INAR 413 BUILDING ECONOMICS**
**LECTURE 06**
**THE FUTURE PERFORMANCE OF BUILDINGS, COST-IN-USE, LIFE CYCLE COST**



**INAR 413 BUILDING ECONOMICS**
**LECTURE 06**
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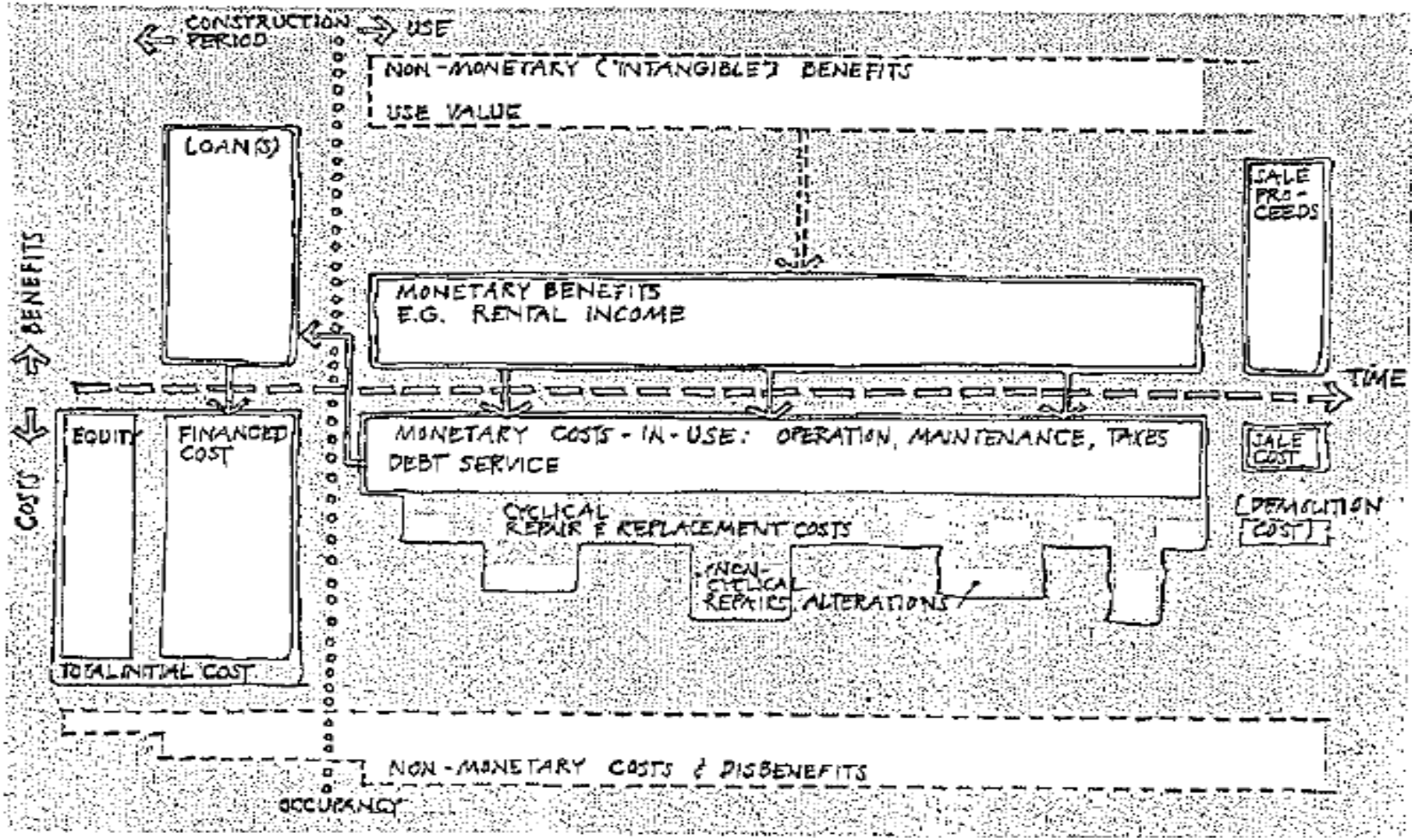
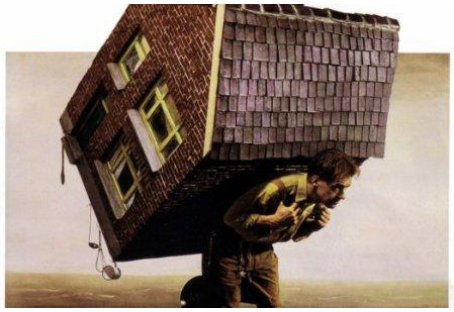
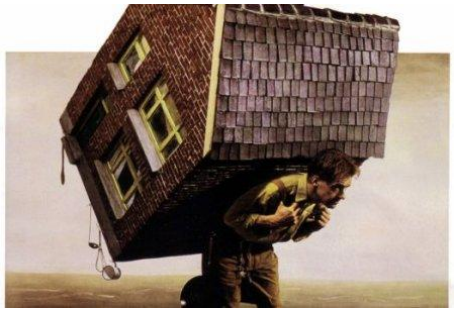


- **OPERATING EXPENSES**
- A number of costs that are necessary to operate a building, maintain it, heat, cool, and service it, and so on, are lumped together as operating costs or operating expenses.
- What these costs are called and how they are grouped often depends on the building type and such things as the arrangements in the lease concerning who pays for which items.
- For example, in a commercial office or an apartment building, the tenant usually is billed directly by the utility company for electricity, water, gas, and so on, used inside the leased space. But there also will be utility charges for the common areas in the building, which are paid by the owner and recovered in the rent. Such costs also include, for example, fuel costs not covered under utilities but provided by the owner/operator of a building (oil, coal, gas); emergency equipment costs; the costs of operating elevators and escalators and of heating and air-conditioning public spaces in the building; and the salaries of operating personnel.

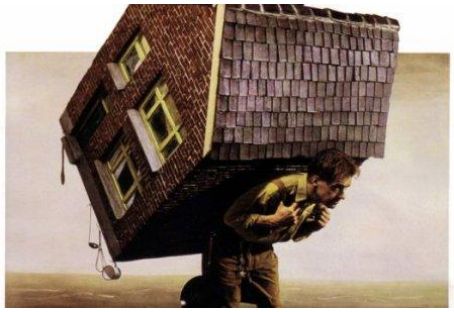


- **OPERATING EXPENSES**
- Operating costs commonly are expressed as TL per square meter of building area per year, but they also can be given in terms of TL per unit of use (work station, hospital bed) or per unit of surface area of building enclosure.
- If an owner is also the user of a building, and the use involves the operation of equipment integrated into the building (fume exhaust hoods in laboratories, cranes conveying equipment, etc.), the task of sorting out operational costs for the building will become rather complex, and they will be difficult to separate from the costs of using the space, for example, production costs of goods manufactured in the building.

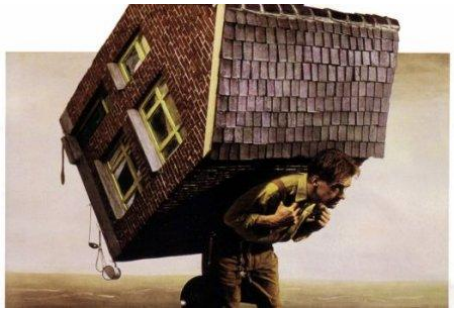


**INAR 413 BUILDING ECONOMICS**
**LECTURE 06**
**THE FUTURE PERFORMANCE OF BUILDINGS, COST-IN-USE, LIFE CYCLE COST**

- **UTILITIES**
- Utility costs cover services provided by the utility company: water, electricity, gas, sewage tax, garbage collection, and so on. Utility costs for the general operation (e.g., outdoor and hallway lighting, elevators, etc.) of a multi-user rental building must be distinguished from the utility costs that can be attributed to specific rented space and therefore charged directly to tenants.
- Rates vary both with location (municipalities have different utility tax rates) and overtime; in many places, different rates apply to small-scale (residential) and heavy (e.g., industrial) users. Rates can be obtained from the local utility office. They are expressed in terms of the metered units for some items: kilowatt-hours, cubic meters of water, gas, sewage, and so forth.
- For other items such as garbage collection, flat fees are charged. In order to make useful estimates of what the utility usage, and thus the costs, will be for a planned project, assumptions must be made about average usage, either per person per time unit and number of users occupying the building or per square meter of floor area per time unit.

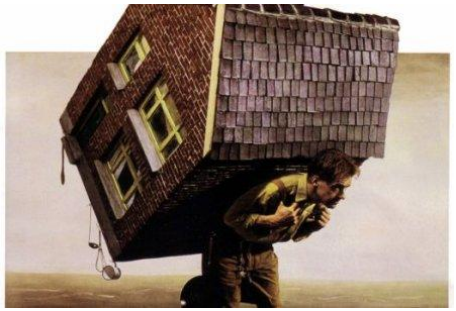



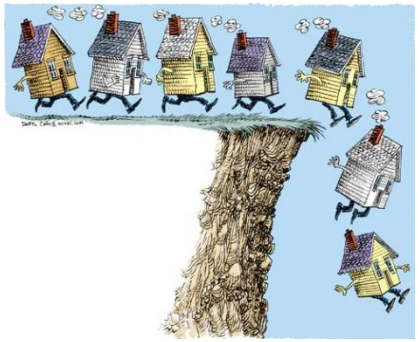
- **UTILITIES**
- For example, the average utility bill for single-family detached dwellings in a neighborhood may be 180 TL per month. Given the average size of the homes, say 150 m2, one might arrive at an average rate per square foot per month of 1,2 TL per m2; for a planned new home of 200 m2, one then would estimate a monthly bill of 240 TL— assuming that general construction methods, appliances, and so on, are similar to those in the average home. Or, knowing that the average occupancy of those homes is 2.5 persons, the average monthly charge per person would be 60 TL, and the estimate for a planned four-person household would be 240 TL.

**INAR 413 BUILDING ECONOMICS**
**LECTURE 06**
**THE FUTURE PERFORMANCE OF BUILDINGS, COST-IN-USE, LIFE CYCLE COST**

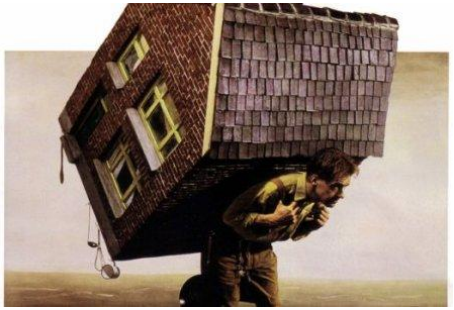
- **UTILITIES**
- Such estimates based on square meter or occupancy averages for the given building type are useful to give a rough idea of expected costs, for programming and feasibility analysis purposes. However, once the considered design solutions deviate from the normal practice, or efforts are made to achieve, for example, greater energy efficiency through design measures, better methods for estimating such items as fuel or electricity use are necessary.
- Again, as with the quantity-takeoff-based estimating methods for initial construction cost, there are reliable detailed estimating methods—for example, for energy requirements for artificial lighting, for household water heating, for heating/cooling/ventilation, and so on. Their use depends on detailed information about the plan layout, construction methods and details, extent of insulation, equipment deployment and efficiency, and so on; mechanical engineering consultants can easily carry out the required calculations for such estimates, given this information. Once more, the architect's dilemma lies in having to make significant decisions at the schematic design stage that are certain to have considerable implications for energy efficiency, for example, before all this detailed information is available, simply because the corresponding decisions have not been made.

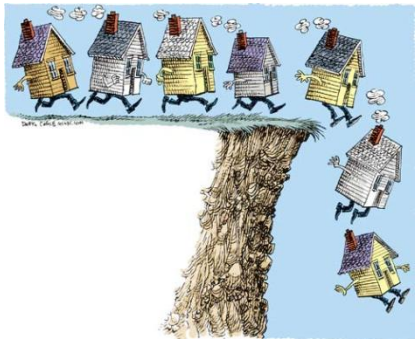





**INAR 413 BUILDING ECONOMICS**
**LECTURE 06**
**THE FUTURE PERFORMANCE OF BUILDINGS, COST-IN-USE, LIFE CYCLE COST**

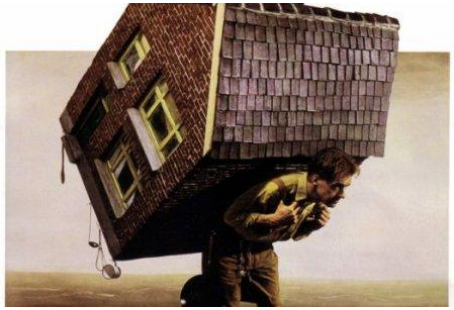
- **UTILITIES**
- What strategies are available to the architect in this situation? For one, a thorough understanding of the energy implications of climate, construction methods, building orientation, and the mechanical equipment used in the building can help the designer avoid blatantly wrong moves, by using this knowledge in an intuitive way.
- Early involvement of consultants to determine the general design strategy also can help if the consultants are willing to look at alternative options with incomplete information.
- Architects sometimes complain that their consultants do not like this imprecise and messy work in the early stages, preferring to take a given solution as it is and to calculate the requirements for it.

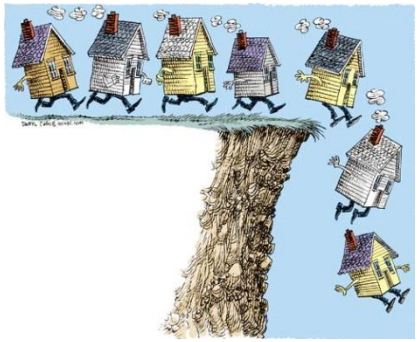





**INAR 413 BUILDING ECONOMICS**
**LECTURE 06**
**THE FUTURE PERFORMANCE OF BUILDINGS, COST-IN-USE, LIFE CYCLE COST**

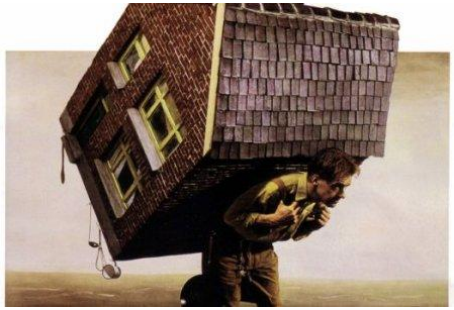
- **UTILITIES**
- Another possibility would be to apply an approach equivalent to that of the enclosure method for estimating initial cost—in fact, to expand the enclosure method into the realm of future costs.
- The problem with this approach, as in the initial cost enclosure method, is that reliable data in the form needed are not readily available. They must be reconstructed from more detailed calculations of specific materials and assemblies, and approximate averages used to reflect the fact that specific decisions about materials and so forth may not have been made at the schematic design stage. But even with rough approximations it is possible to get a good sense of the relative cost effects of schematic design trade-off decisions. The model can include cost assumptions for other kinds in-use costs (e.g., maintenance costs), If accurate cost data are not available, indicators such as the perimeter-area ratio or surface-volume ratio for a building can provide guidance for the design effort.

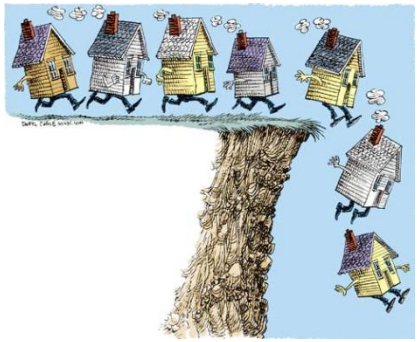





**INAR 413 BUILDING ECONOMICS**
**LECTURE 06**
**THE FUTURE PERFORMANCE OF BUILDINGS, COST-IN-USE, LIFE CYCLE COST**

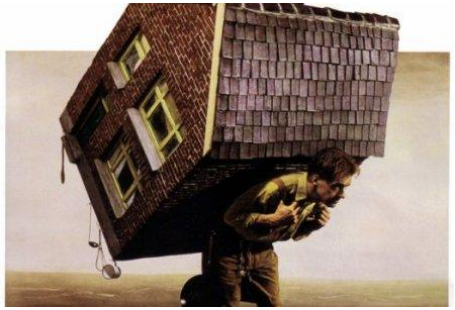
- **MAINTENANCE COSTS**
- This item includes janitorial services and cleaning crews, window washers, painting, wall finish upkeep, fixture cleaning, monitoring and servicing of mechanical equipment, and so on.
- Data for maintenance costs are available in various formats from different sources. One format would be records of the client's own organization if it is a corporation or institution that already owns and operates a number of facilities of the same type. Associations and government departments responsible for certain building types also keep records of such data, such as those for shopping malls, hospitals, educational facilities, hotels and motels, and so on.
- Data of this land should be viewed and used with considerable caution because they are subject to manipulation by the owner.
- Also, policies differ widely as to what level of maintenance is adequate and appropriate.

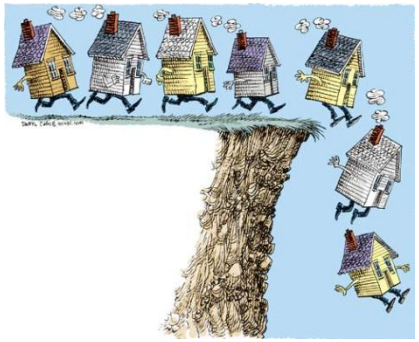





**INAR 413 BUILDING ECONOMICS**
**LECTURE 06**
**THE FUTURE PERFORMANCE OF BUILDINGS, COST-IN-USE, LIFE CYCLE COST**

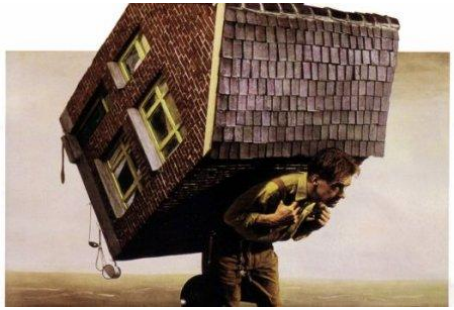
- **MAINTENANCE COSTS**
- Should the building be kept at its initial value and utility (e.g., income-producing ability) for a time that in theory could be indefinite? Or should it meet a rising standard, being adapted to new technology and quality expectations over time? Or should the building simply be kept in acceptable working condition up to the end of its expected life span, allowing for a decreasing quality standard with age and obsolescence? The various trade-off decisions involving maintenance costs are well known and recurring:
- Should a more expensive material be used in expectation of lower maintenance costs over the years? Even if it must be replaced earlier? Should more insulation be added to the exterior enclosure (insulation in walk, insulating glass in windows, etc.) in the hope of reducing the continuing fuel costs, which are expected to rise even faster in the future?
- Grounds maintenance refers to the costs of cleaning the outdoor premises, such as lawn maintenance, trimming, landscaping services, and trash collection,

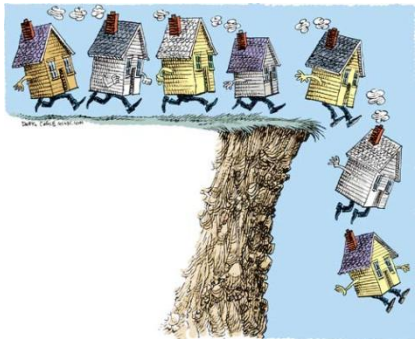




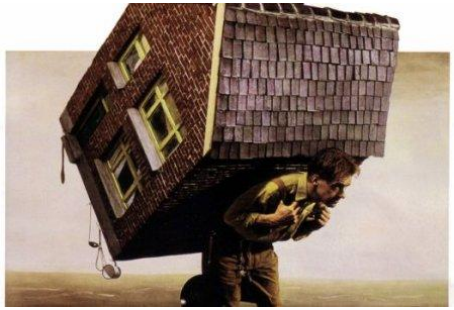
**INAR 413 BUILDING ECONOMICS**
**LECTURE 06**
**THE FUTURE PERFORMANCE OF BUILDINGS, COST-IN-USE, LIFE CYCLE COST**

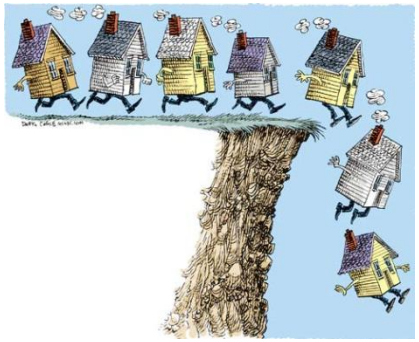
- **ADMINISTRATIVE COSTS**
- ***Management***. The costs of managing the building can vary considerably, depending on the type of building, the tenant turnover rate, the type of lease or rental agreement, the need for advertising, whether the owner or the owner company performs these duties in-house or engages outside help, and so on.
- They would be expressed, for example, in terms of TL per square meter per year, or TL per unit (say, apartment, hotel room. etc.) per year. There is little evidence for a straightforward relationship between design features and management costs that might or should influence design.
- Accounting and legal costs might be listed under this heading or separately.



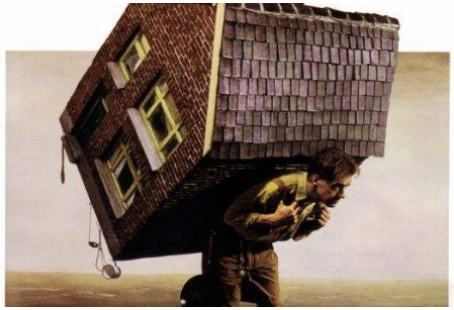


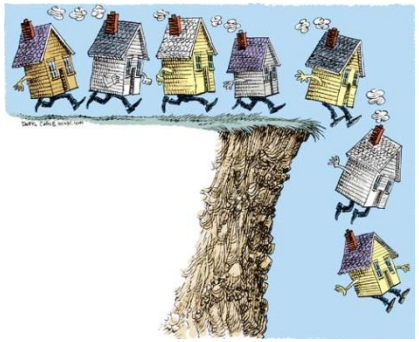
- **ADMINISTRATIVE COSTS**
- ***Security Costs***. These costs can include the operation and maintenance, for example, of electronic security systems and/or the services of night security guards or security firms.
- Again, cost assumptions would be expressed on a TL-per-square-meter basis. While the relationship between design and the likelihood of crime in a building or neighborhood has been pointed out forcefully by authors such as Newman (see his *Defensible Space}* the impact of design decisions on the required level of security expenditure is much less clear.
- A great deal also depends on the location of the project.



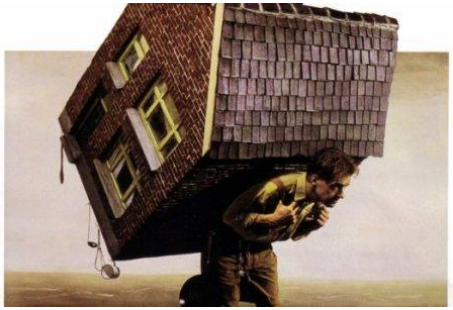


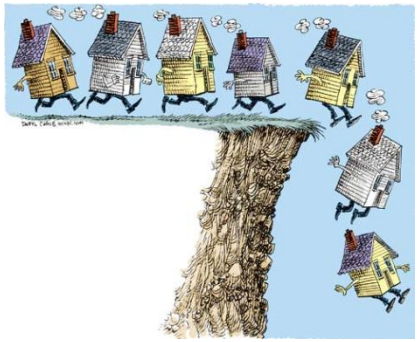
- **ADMINISTRATIVE COSTS**
- ***Insurance***. The cost of insurance coverage for a given building project depends very much on the nature and the use of the building, the kinds of hazards covered, the level of risk associated with each, and the level of competition among insurance companies offering a particular kind of coverage.
- Hazards and risk depend in turn on construction methods and materials, as well as the location (e.g., distance from fire stations and fire hydrants; also there are maps showing the expected frequency and levels of floods for the purpose of flood insurance, and insurance companies keep records of the number of burglaries or fires in different neighborhoods and use them to determine risks and premiums). It thus is difficult to give general reliable averages for the purpose of long-term insurance cost estimation. It will be necessary to obtain data from nearby similar buildings, or to conduct inquiries with insurance representatives for each particular project.





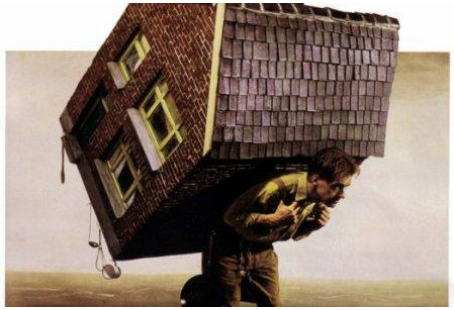
- **ADMINISTRATIVE COSTS**
- ***Telephone and Other Communications Charges.*** Again, a distinction must be made between the general service for a building (public phones, basic service and hookups provided, service to the manager's office, etc.) and the specific user (tenant) charges that can be metered and charged to individual user accounts.

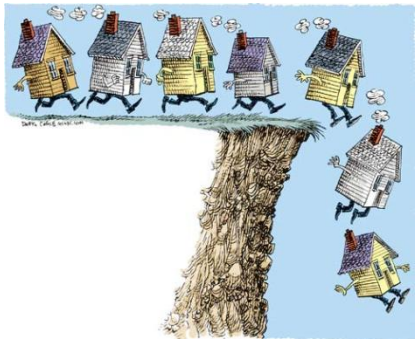




**INAR 413 BUILDING ECONOMICS**
**LECTURE 06**
**THE FUTURE PERFORMANCE OF BUILDINGS, COST-IN-USE, LIFE CYCLE COST**

- **DEBT SERVICE**
- The term "debt service" refers to the periodic (monthly or annual) payments required to pay back the mortgage loan for the construction or acquisition of a building.
- These payments usually are arranged to be constant (the same amount every year or month). Conceptually they are kept separate from other annual expenses, which will vary with inflation or other price fluctuations.
- There may be several loans or mortgages involved, especially in larger projects. Debt service payments most likely constitute a major part of the costs to be paid in connection with the use of a building.
- They are the initial costs (plus financing charges) spread out over time.





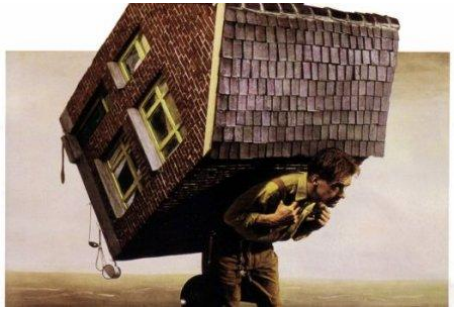
**INAR 413 BUILDING ECONOMICS**
**LECTURE 06**
**THE FUTURE PERFORMANCE OF BUILDINGS, COST-IN-USE, LIFE CYCLE COST**

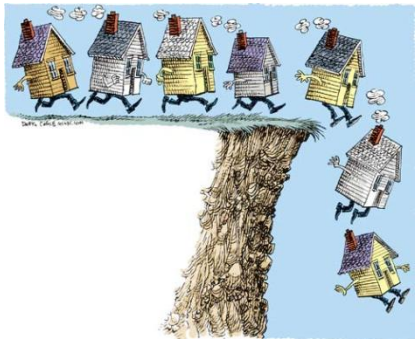
- **TAXES**
- ***Real Estate Taxes***. These are local (city or county) property taxes based on the assessed value of the property— site and buildings. The determination of the value of a real estate project is made by a property appraiser. The tax is calculated by multiplying the tax rate by the assessed value. The tax rate is set by the local government.
- The assessed value must be obtained from the property appraiser's office. The appraiser uses three basic approaches (or a combination of them) to determine the value of a building:
- 1. Replacement cost: this refers to what it would cost to replace the building with either
- (a) An equivalent one (one that serves the same purpose) or
- (b) An identical one (this is also called reproduction cost)
- Usually, approach (a) will be used; method (b) is appropriate for buildings of historical significance.
- 2. Market value (what similar buildings in the neighborhood sell for).
- 3. The present value of potential income the building can produce over its remaining useful life.
- In many areas and municipalities, the assessed values of real estate differ from market values, in that properties systematically are assessed below reasonable market estimates. Real estate taxes and insurance often are grouped together as fixed expenses because they do not vary with occupancy and use.

- **TAXES**
- ***Sales Taxes***. Depending on the location of a property, there will be local and/or state sales taxes for rentals and lease payments. If the rentals are calculated on a cost basis (rent required to cover debt service, operation costs, developer profit, etc.), these taxes must be added to the rental rates.
- ***Income Tax***. Of interest here is the tax—federal and state tax where applicable—on the income (the cash throw-off or cash flow left after subtracting expenses and debt service from the effective gross income, minus depreciation allowance and replacement reserves) from the building every year.
- However, the rate at which income tax is calculated (the tax bracket) depends on the total income of a particular taxpayer and must be ascertained case by case. Also, tax rates may vary from year to year. For this reason, comparative assessments of the economic viability of building projects as it is influenced by design decisions are more meaningful based on "before tax" performance, whereas the owner obviously is concerned with the final "after tax" outcome.

**INAR 413 BUILDING ECONOMICS**
**LECTURE 06**
**THE FUTURE PERFORMANCE OF BUILDINGS, COST-IN-USE, LIFE CYCLE COST**

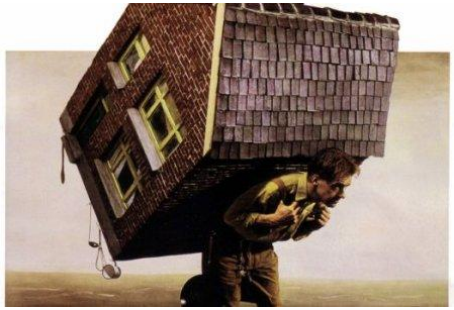
- **TAXES**
- ***Capital Gains Tax***. Unlike the income tax, which is paid every year, the capital gains tax is paid only at the time of sale of the property, on the capital gain (Le., the difference between the acquisition cost of a building and the sale price if the latter is greater than the acquisition cost).
- The tax law distinguishes between short-term (for property held less than a year) and long-term capital gains (for property held for a longer period). An exception is that anyone over age 55 selling a private residence is not liable for capital gains taxes for one such transaction during a lifetime. The capital gains tax rate also depends on the taxpayer's tax bracket

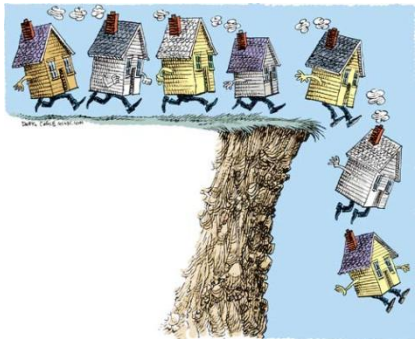




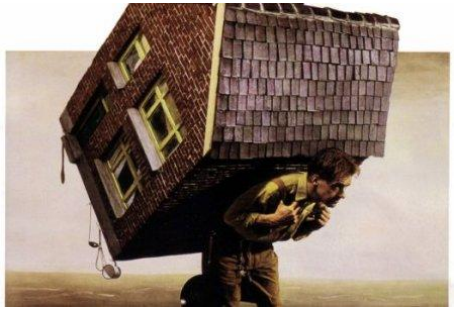
**INAR 413 BUILDING ECONOMICS**
**LECTURE 06**
**THE FUTURE PERFORMANCE OF BUILDINGS, COST-IN-USE, LIFE CYCLE COST**

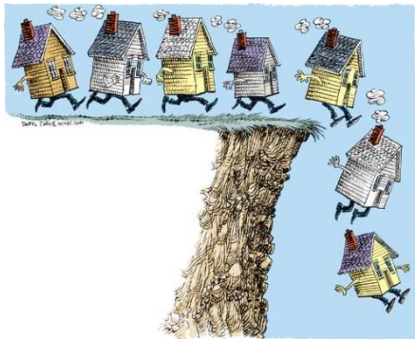
- **REPAIR AND REPLACEMENT COST**
- ***Repair Costs***. Building components not only require maintenance, but every once in a while will suffer breakdowns and need to be repaired. Experience allows us to estimate the average time between repairs for different types of components, and the average cost of the repair. The necessary repair funds usually are estimated as average annual costs that must be set aside in order to enable payment for the needed repairs when they occur.
- ***Replacement Costs***. If a building component cannot be repaired, it will have to be replaced. It may be difficult to draw a clear line between items often covered under maintenance such as the continuous replacement of worn-out or broken light bulbs, which is carried out by maintenance staff, and the more infrequent replacement of items such as broken windows, worn-out carpets, major appliances, HVAC systems, and building parts. Repair costs often are associated with at least some replacement and so are often listed with replacement costs.



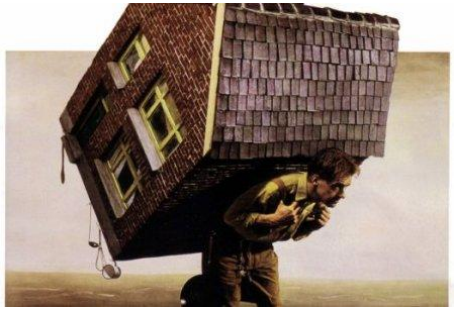
- **REPAIR AND REPLACEMENT COST**
- ***Replacement Reserve.*** If the building must be replaced with a new facility at the end of its useful life, and the costs for the new building must be generated with the income from the old one, an annual replacement reserve must be provided for, to be paid into a fund set aside for this purpose.
- The rationale is the same as that behind the depreciation tax allowance: to ensure that sufficient funds will be available to provide for another facility, given that it may have to be replaced or sold at its reduced (depredated) value.
- The amount that should be set aside is a matter of policy. At least, the amount for a down payment (equity contribution) for a new building of the same size should be considered.

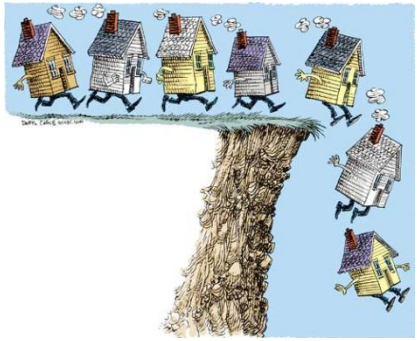




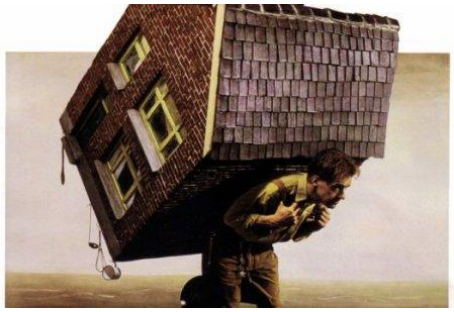
**INAR 413 BUILDING ECONOMICS**
**LECTURE 06**
**THE FUTURE PERFORMANCE OF BUILDINGS, COST-IN-USE, LIFE CYCLE COST**

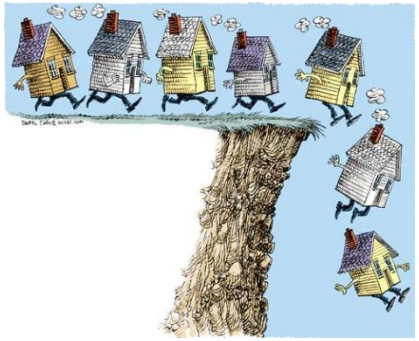
- **RENOVATION, ALTERATION, ADDITION COSTS**
- To maintain a building's ability to serve its purpose over time, it is necessary to do more than just maintenance and repair/replacement of unserviceable components. As needs and purposes change, the building must be adapted to these changes. Renovations and alterations, redecoration, and, at the extreme, addition and expansion are different forms of such adaptation, and the costs of these measures must be included as regular elements of the cost of ownership.
- Some of these costs should be anticipated to occur on a regular schedule, such as redecoration, painting, and the like, and could be included under the category of regular maintenance costs. More far-reaching alterations and remodeling will be less predictable, occurring in connection with major tenant changes or adjustments to shifts in market conditions. It is useful to include a regular fund for such expenses so that they can be paid for as they occur without causing serious disruptions of cash flow.





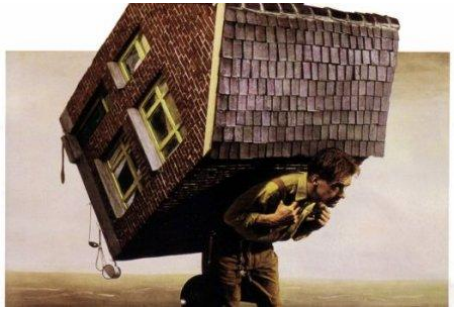
- **MISCELLANEOUS COSTS AND EXPENSES**
- **Vacancy *and Bad Debt Losses***. These actually are reductions of rental income but usually are referred to as expenses or costs.
- Vacancy refers to the amount of rental space that is not occupied and rented at a given time, and which therefore does not produce rental income.
- Any change of tenant will cause a vacancy for some time; as the space must be cleaned, painted, re-furbished, and so on. Expressed as an average percentage rate (of total amount of net leasable area, for example) or as its inverse, the occupancy rate (100% minus vacancy rate), it will reflect the overall attractiveness and competitiveness of the rental facility in the marketplace.
- Overall market conditions must be considered in estimating vacancy losses.
- "Bad debt" refers to rents not paid (or paid late) for premises that actually are occupied, or those owed by tenants who have moved out without paying the last few months' rent.

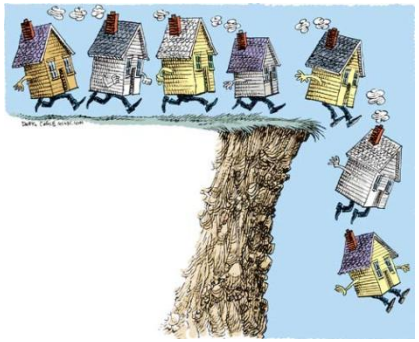




**INAR 413 BUILDING ECONOMICS**
**LECTURE 06**
**THE FUTURE PERFORMANCE OF BUILDINGS, COST-IN-USE, LIFE CYCLE COST**

- **MISCELLANEOUS COSTS AND EXPENSES**
- ***Contingency Allowances***. Allowances for unforeseen expenses, damages, legal bills, and the like, should be included either as a per-square-meter figure or as a percentage of rental income.
- ***Sale costs*** are the costs involved in selling property —either the realtor fees (usually 6% or 7% of the effective sale price) or the costs incurred in the owner's own efforts to sell the property: advertising costs and time spent in showing the building to prospective buyers, negotiations, and so on. Also, where applicable, they include sales taxes on the sale price of the building (which are different from the sales taxes on rents mentioned above).
- ***Demolition costs*** involve the cost of tearing down the building if it must be removed, and of hauling away





- **NONMONETARY COSTS**
- The discussion thus far does not include the nonmonetary costs that may be associated with the planned project over its lifetime of use. Even if the economic impact of such costs is not directly visible, people often are quite willing to incur monetary costs in order to avoid or reduce such intangible costs—just as people are willing to pay for nonmonetary benefit. Or there may be indirect economic consequences of such intangibles later, so that it is a matter of common sense at least to identify these costs, perhaps making explicit what monetary cost differences would be involved in their avoidance or reduction and allowing those involved to make conscious trade-off decisions on their own.
- Of course, raising this question opens up a wide field of concerns, ranging from architectural qualities and their relationship to user needs to questions of the wider environmental impact of a project: increase in traffic, loss of trees and vegetation, loss of views or sun incidence at certain times of the day for neighboring properties, pollution, storm-water runoff with the possibility of flooding in lower-lying areas downstream, and changes in neighborhood scale, character, and use patterns or property values, to name but a few such effects.
- From the brief list of examples of the intangible costs of building projects, it also becomes clear that one of the problems is with the distribution of such costs over the set of parties involved in a project or affected by it in some way; although the monetary costs discussed above all are borne by the owner (or tenant) of the project itself (Just as its benefits are assumed to accrue to the owner), many of the intangible costs are imposed upon neighbors or other members of society.