

CHAPTER FOUR

ACHIEVING A GREAT BUILDING: CONSTRUCTION PROCESS AND COST CONTROL

TO REACH OUR AIMS AND ASPIRATIONS, THIS BUILDING MUST
BE BUILT BY ENTIRELY NEW MANAGEMENT TECHNIQUES

The kind of building which the Mary Rose Museum aspires to be is one in which each part is married to the whole, and comes out of the whole—a work standing in the ancient tradition of architecture, but of our time on the threshold of the twenty-first century. Such a building cannot be made from plans drawn by an architect, then simply executed by a building contractor. It must be built by means very different from the means that have been used for building during the last fifty years.

The reason is fundamental. In the evolution of any great work of art, each detail becomes modified by thought, as the building work proceeds. This is what happened to the stone masons who built the great medieval cathedrals. Each stone they carved, was carved in relation to the evolving whole, and therefore took its place correctly.

A NEW APPROACH TO
CONSTRUCTION
MANAGEMENT

Our experience as contractors, engineers, and architects during the last fifteen years has proved one thing over and over again: the things placed on drawings are inevitably—always—wrong in many particulars. Drawings serve as an important rough sketch of something that will be built, but must be executed with constant attention to room shape, light, wall and ceiling detail, openings—above all to the feelings which arise in each place, in the construction, as it is taking shape. These feelings are too complicated to predict, and *cannot* be predicted. When a building is built from plans that are conceived on the drawing board, and then simply built, the result is sterile at best—silly most of the time—and sometimes unthinkable bad. This is something familiar in virtually all large buildings that have been

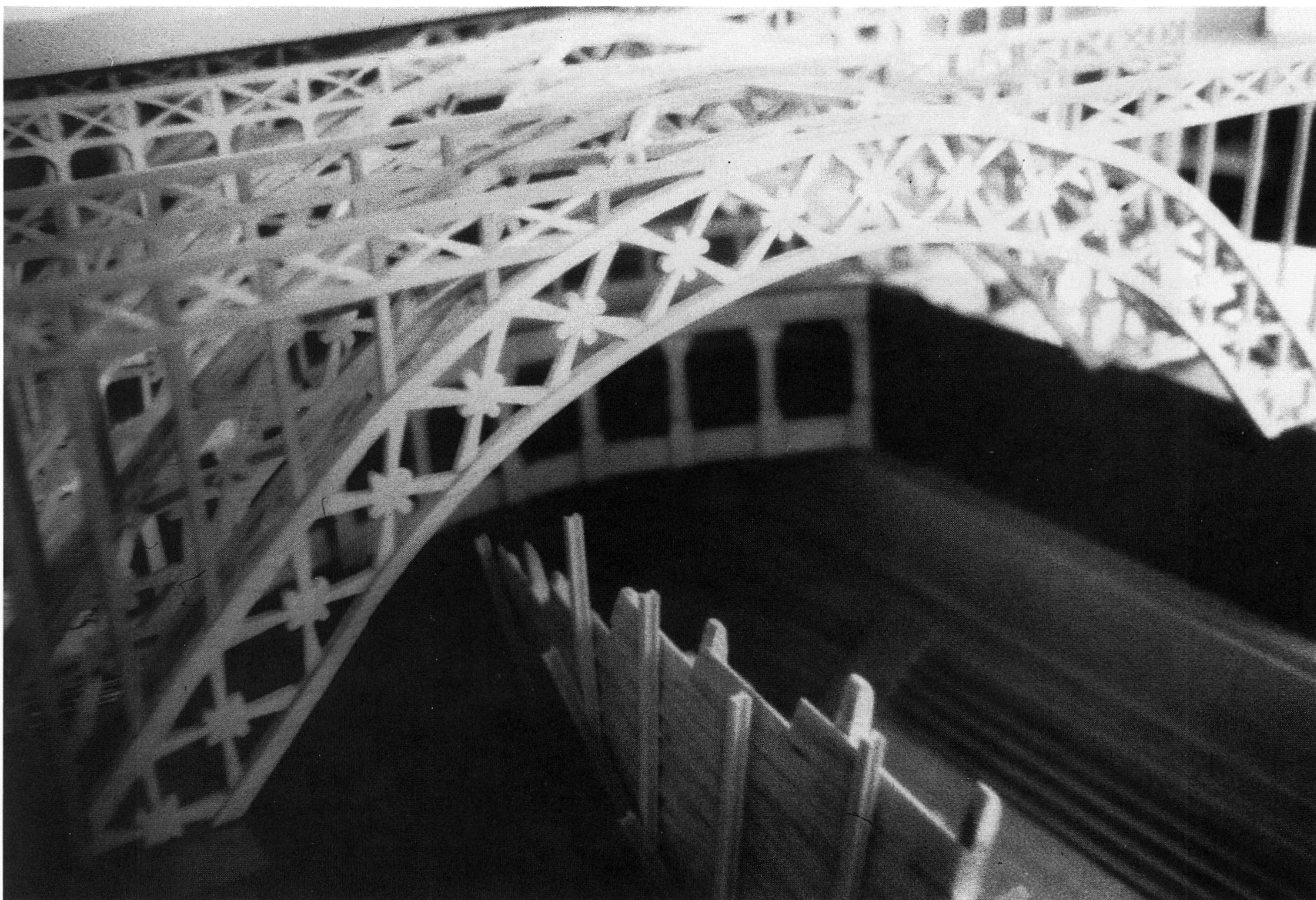
built since 1950. It is inevitable, given the process of construction used to build them. And it is inevitable that this process must lead to unsatisfactory results.

Recent developments in the construction industry have tended to separate design from construction even further. A process has recently developed where the architect—like a fashion designer dealing with concepts—only sketches the building. That building is then detailed and built by a construction management firm, who create the details in their own offices or using other architects, based on a more solid knowledge of construction process and technique, and then have the building built. The result, of course, is even worse since the building has now been conceived by a fashion designer to whom the fabric and structure of the building is not real.

To build the Mary Rose Museum, we propose to use a form of construction management that is entirely different,

one which we have practiced successfully many times over in the United States and in Japan. In this technique, time and cost control are handled by a flexible management team, who have the knowledge, and the authority, to modify the building continuously—with the client's help and knowledge—while keeping the flow of construction and subcontractor operations on target with regard to time and cost.

This technique is not well known in England, although a relative of the CES construction management system does exist there, in a different form, and has been practiced with success by large companies such as Bovis. In these systems, the flexible management is designed for a different purpose: the design is kept constant, while time or cost is reduced. The reduction is achieved by flexible operations which give the managers the chance to make a continuous stream of changes in specifications, details, or scheduling, but

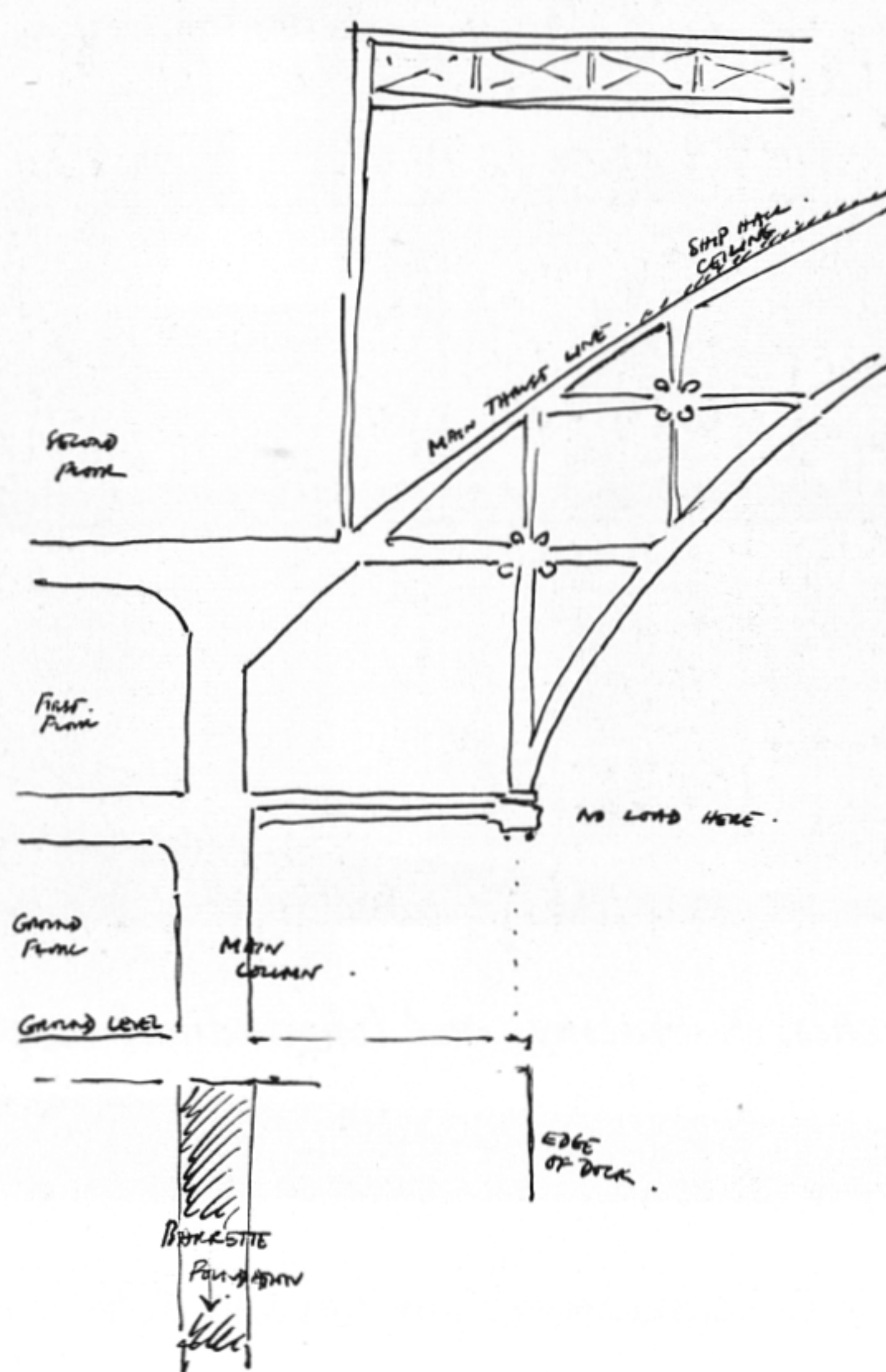


The beauty and delicacy of the massive lightweight structure

always designed to reduce time, or to reduce cost.

The system which we have developed has a similar flexible method of management, and uses very similar techniques, but to achieve very different goals. Again, the specifications, details, and scheduling are changed, while construction is moving forward—and again this is achieved with an experienced team of construction managers, accustomed to flexible operations. However, in the CES system, the goal is different. Our intention is to increase the *quality* of the building, while leaving cost and time unchanged. Thus the savings which are achieved through the use of flexible management

and control over the emerging building, are used to improve *quality* while keeping cost and time fixed.



CONSTRUCTION CONTRACTS

The process of construction described in this chapter, and which we contemplate for the Mary Rose Museum, requires an entirely new relation between architect, contractor, and sub-contractors, and a new understanding of the relationship between time and flow of money.

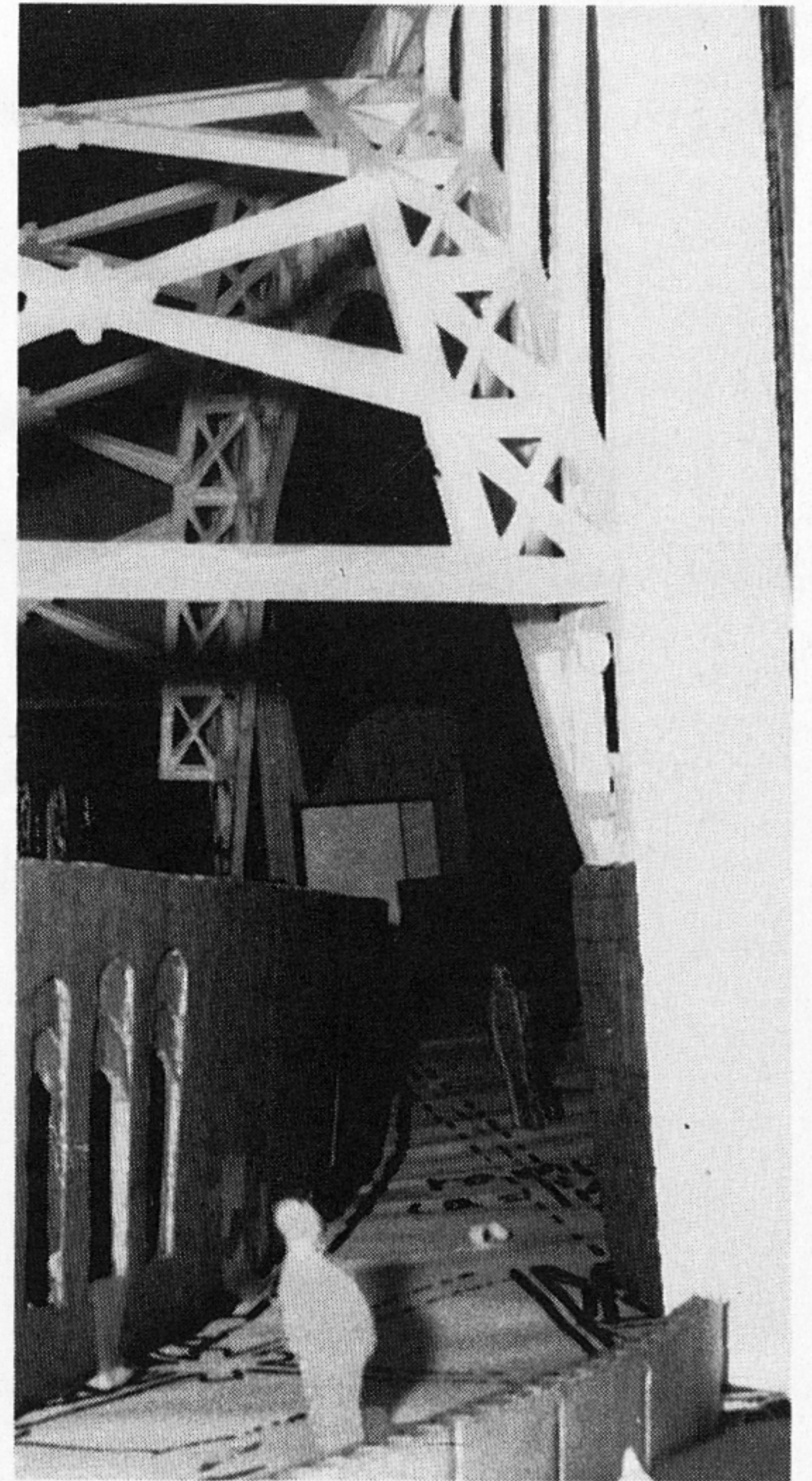
The new relation includes the concept that the construction management is headed by the architect, as construction manager. It requires the use of entirely new construction management techniques, and above all, of new contracts. These new contracts address these issues head-on.

For the sake of illustration, at the end of this chapter we reprint two standard contracts currently used by CES in California. They are not the contracts we use for larger jobs, and they will certainly require substantial modification to conform to English legal usage and to English construction practice for the Mary Rose Museum. We print them here because they illustrate, succinctly and clearly, the principles of construction advocated by CES. They describe both the emotional spirit, and the legal essence, of the contracts which we would use in building the Mary Rose Museum.

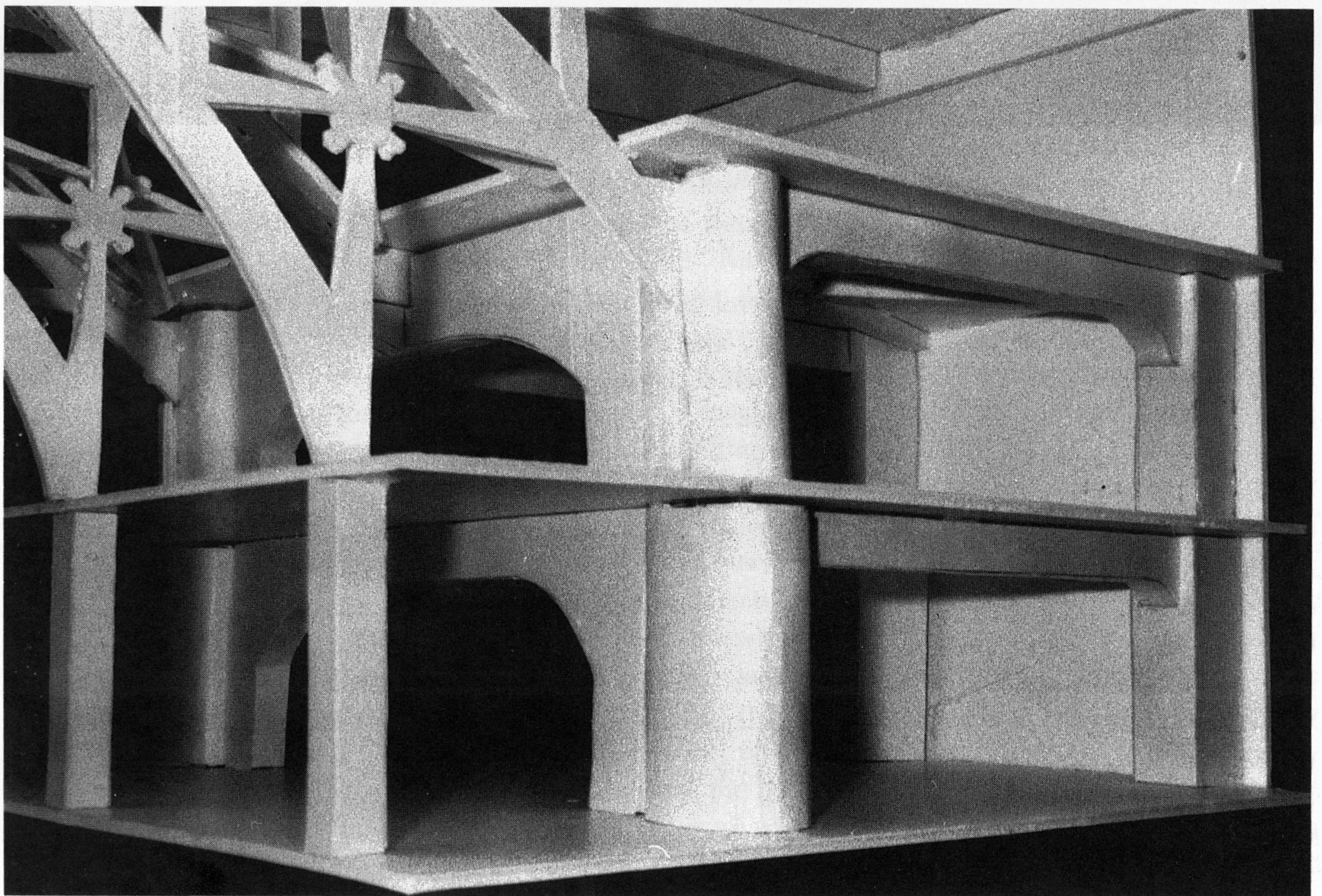
It may seem unusual to print construction contracts in a book of this type. The mainstream view of architecture to-

day ignores the relation of construction management to architecture; treats it as a mundane matter, one of no great importance. It is significant that most students in architecture schools do not study construction contracts; and even on the rare occasions when this might be done it is treated as a boring, practical matter, on a par with having to know something about the way the plumbing works.

Yet the truth is that the contract, which sets out the expectations, conditions, and essence of the bargain which is made with craftspeople to get the building built, has in its fine print, the nature of architecture writ large. The RIBA¹³ and AIA¹⁴ contracts in common use today are themselves in large



The entrance ramp passing through the ship hall



Main arches, X-bracing, and longitudinal support arches

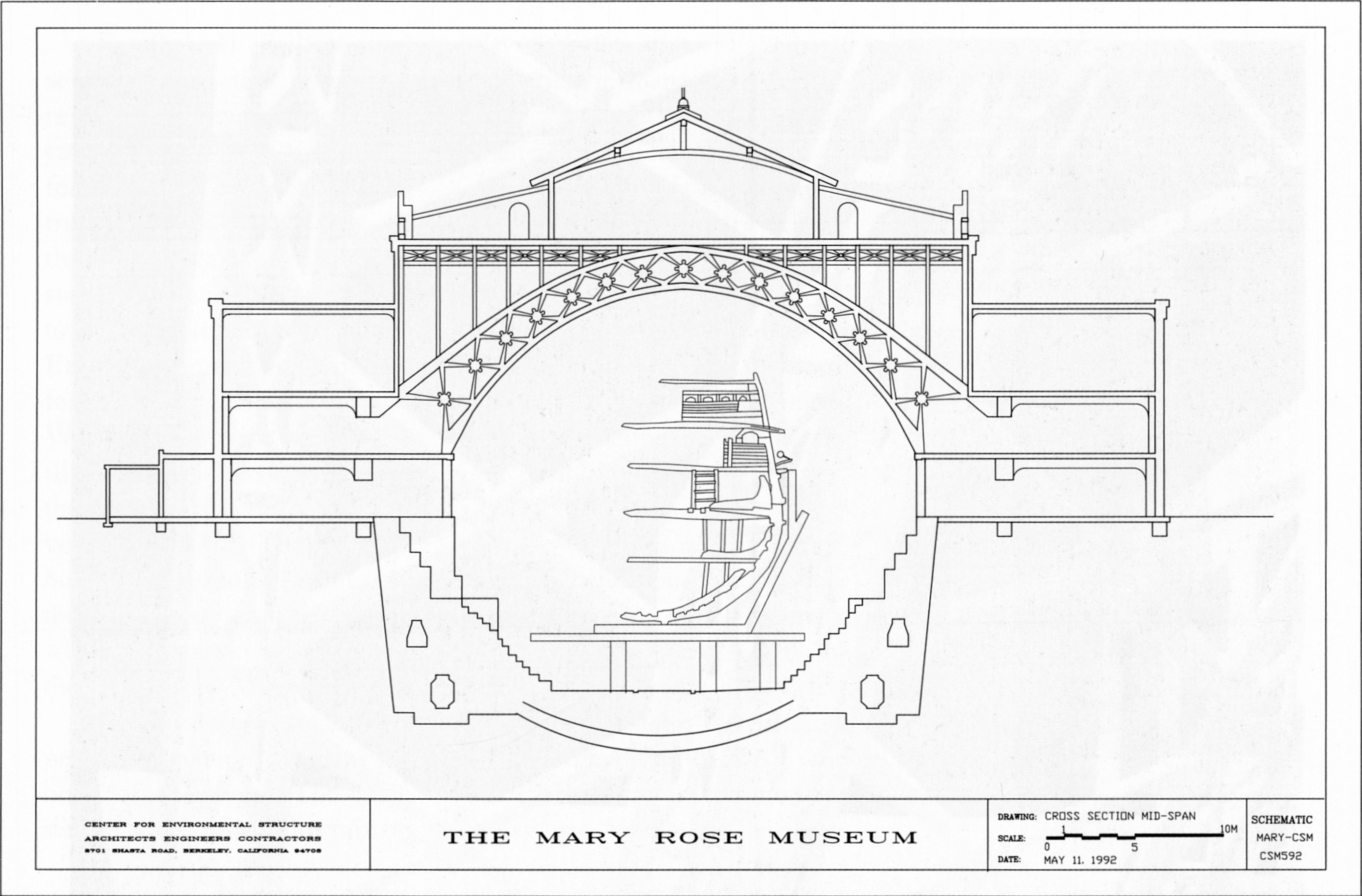
13 Royal Institute of British Architects.

14 American Institute of Architects.

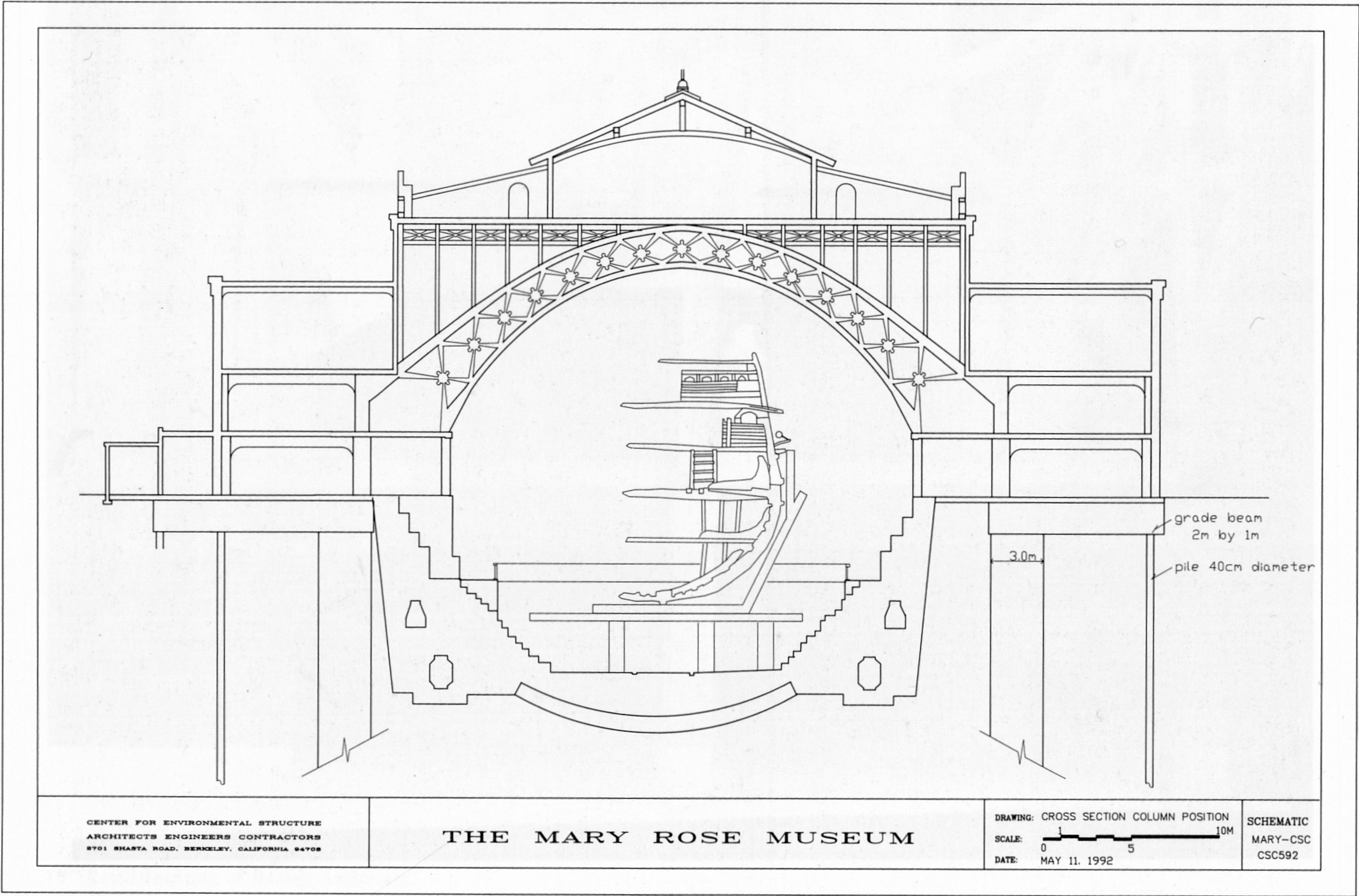


Another view of X-bracing and longitudinal arch system

THE MARY ROSE MUSEUM



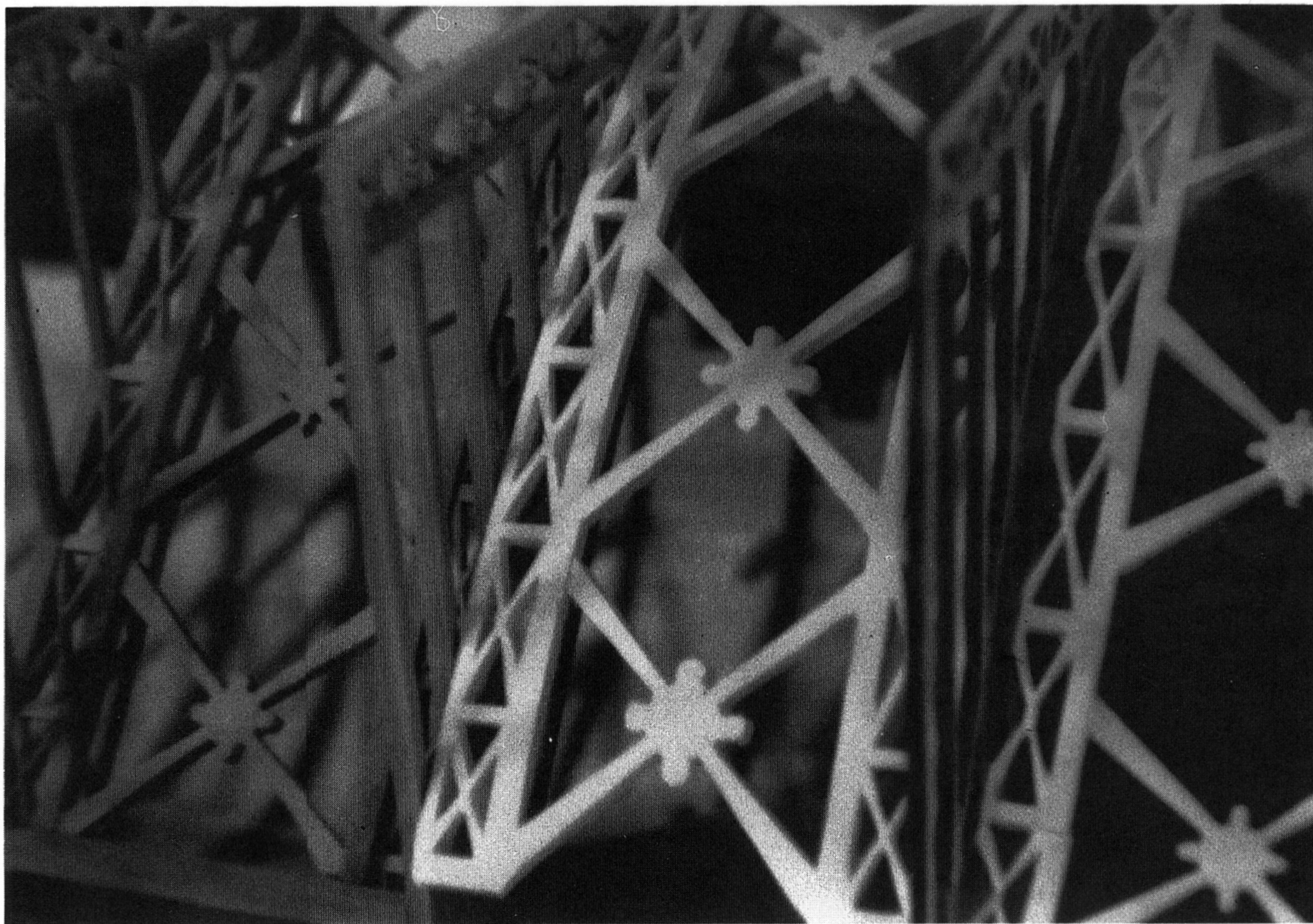
Cross section at the mid-span of the longitudinal arches



Cross section at a typical major pier



The hull of the Mary Rose as seen against the arches



Tracery of the major arch structure

part responsible for the lamentable state of architecture. It is almost true to say that a good building cannot be built within the kind of arrangement contemplated in a "normal" contract.

TIME AND MONEY

Present-day contracts are not only faulty because they take control away from architects and weaken their relation to the evolving building and to the crafts involved. They also all but destroy the building through the system of incentives which they create for the contractor, in regard to time and flow of money.

In the current system, the contractor builds a portion of the building with his own money and receives "draws" once particular phases are complete.¹⁵ This system, ostensibly set up to keep the contractor honest, and to keep the project moving forward, does enormous harm to the building, doesn't benefit the client, and puts the contractor in a state of stress where the only thing he can think about is going as fast as possible in order to invoice the next draw. Under these conditions, where money is used to enforce time constraints, it is impossible to build a profound building.

In the CES system it works differently. We realized long ago that the draw system is a fundamental problem with present-day construction practice that must be solved if "good buildings" are to be built once again. In response, we began a series of experiments with new types of construction management, starting eleven years ago

with one building in Albany, California, in which our construction contract allowed the proper relation between time, money, and incentives to exist on the job. During subsequent years, we have continually evolved our construction contracts to address this problem of money flow, as it relates to time. In these contracts the tasks are broken down into much smaller segments. Where a "typical" contract would call for five draws, our contract has thirty to thirty-five operations, each with its own draws. In addition, the contractor is paid for a portion of the work up front before it is performed, and for the rest of the work as it is performed.

Within any one of the thirty or so operations, the contractor receives 50% of the money for that operation up front, 35% when he has completed about 50 to 60% of the work, and the remaining 15% when that operation is entirely done. The basic principle is that contractors are never working on their own money, and are therefore never rushing to clear a loan. In the case of a retention (normally 10%) they receive 5% upon completion of the operation and 5% on completion of the job.

Under these conditions, the contractor can afford to stop and look around, to begin to understand what is happening to the building, to pay attention to the *needs* of the building as it evolves, and to take care of those needs. Without this modified payment schedule, no amount of goodwill on the part of the contractor can solve the problem, because the money-time relationship will force the contractor

into a situation where he will have to move as fast as possible, and if the building suffers, so be it.

COST ALLOCATION

The driving engine for the new system of management which we use, is a method of cost allocation which *precedes design*. In conventional building design, the architects and engineers design the building, and a cost estimate is then made—in England by a quantity surveyor, in the United States by an estimator. Efforts are then made to reconcile cost overruns with the design, and the design is modified. It is always too late in the game.

In the CES management system, the distribution of money is used, from the first day, to drive the design process. Before almost any geometrical conception of the building design is made, the building is designed as a set of numbers, representing dollar amounts. The building is first assigned a target price: the budget. Main categories are then set up, for all capital construction costs, and the target budget is distributed, intuitively, among these amounts. This intuition relies heavily on experience. But even in the very first distribution of funds among different capital cost categories, one already develops a sense of the building. Amounts are distributed to walls, roof, floors, windows, exterior work, interior finishes, and so on. Even in this first crude distribution of money, one senses the nature of the building which is to be made.

¹⁵ A draw is a designated amount to be received by the contractor after completion of a certain phase of work.

For example, in CES practice for house construction, we almost invariably assign 20% of the budget to exterior works. This means that fully one-fifth of the building cost is to be spent on exterior construction — walls, steps, trellises, seats, and so on, thus forming a zone of carefully tended construction around the house, which extends the cared-for environment far beyond the building itself. Experience shows that this always pays off, and enlarges the valuable environment of the house. But it has to be paid for. By comparison with a conventional approach in which perhaps 5% might be assigned to landscape, this assignation of 20% reduces the house “itself” from 95%

(100% minus 5% in conventional practice) to 80% (100% minus 20% in CES practice). Immediately one has a sense of the way that the distribution of money is working, and how it is defining and affecting the environment.

In the same way, to a practiced eye, this allocation of funds to the building and its elements, gives a complete picture of the design, in its essence, long before the building has even been conceived in plan or in volume. It is the most essential phase in the building process.

On this page and the next we show sample budget allocation sheets of this kind which we made for the Mary Rose Museum long before it was designed.

COST CONTROL
DURING DESIGN AND
CONSTRUCTION

The overall cost allocation picture becomes the channel through which the design is continually reprocessed, thus keeping each part of the building on budget, both during design, and during construction.

Once the cost allocation has been defined, we use it as a basis for making decisions about design. The essence of the process we follow is that we do not allow cost overruns in one category to reduce costs in another, since this would almost always sacrifice the quality of the building.

To go on with the example of the 20% allocation to exterior

COST ALLOCATIONS FOR MUSEUM AND VICTORY ARENA, FULLY FITTED OUT		
CATEGORY	COST	TOTALS
BUILDING SHELL		
Foundations and slabs	£ 736,000	
Main structure	3,811,000	
Additional shell items	432,000	
SUBTOTAL	4,979,000	£4,979,000
MUSEUM FITTING OUT AND FINISHES		
Mechanical systems	1,020,000	
Finishes	756,000	
Ship hall interior	276,000	
Exhibit interior	1,633,000	
Other interiors	263,000	
SUBTOTAL	3,948,000	£3,948,000
SPECIAL EXHIBIT		
Ship model, pond, wind tunnel	664,000	
SUBTOTAL	664,000	£664,000
RESTAURANT AND SHOP INTERIORS		
Restaurant and shop interiors	566,000	
SUBTOTAL	566,000	£566,000
VICTORY PLAZA		
Victory Plaza	1,043,000	
SUBTOTAL	1,043,000	£1,043,000
GRAND TOTAL		£11,200,000

COST ALLOCATIONS FOR BUILDING SHELL			
CATEGORY	UNIT	UNIT PRICE	COST
MAIN STRUCTURE			
Main arch trusses	11	50,000	550,000
Truss arch bracing	10 bays	17,000	170,000
Columns	247	200	49,400
Vaults	2,416 m ²	200/m ²	483,200
Tent rehang from trusses	1 allow	15,000	15,000
Purlins	1,030 m	15/m	15,450
Load-bearing walls	4,467 m ²	140/m ²	625,380
Upper level structural slab floors	3,934 m ²	100/m ²	393,400
Flat roof structure	2,580 m ²	70/m ²	180,600
Pitched roof structure	2,121 m ²	75/m ²	159,075
Pitched roof surface	2,121 m ²	30/m ²	63,630
Flat roof surface	2,580 m ²	20/m ²	51,600
Restaurant trusses and buttresses	11	6,000 ea	66,000
			<u>2,822,735</u>
Contingency	15%	2,822,735	432,410
Management	20%	2,822,735	<u>564,547</u>
SUBTOTAL			£3,819,692
FOUNDATION AND SLABS			
Demolition	1 allow	20,000	20,000
Drilling and piers vertical piers	101	1,000 ea	101,000
Drilling and piers battered piers	72	2,000 ea	144,000
Grade bms 90 cm by 60 cm by total length 1,552 m	838 cm	130/cm	108,940
Slabs on grade, 30 cm	535 cm	100 cm	53,500
Other ground floor slabs	1,283 m ²	80/m ²	102,640
Tie beams, steel	104 m	150 m	<u>15,600</u>
			545,680
Contingency	15%	545,680	81,852
Management	20%	545,680	<u>109,136</u>
SUBTOTAL			£736,668
ADDITIONAL SHELL ITEMS			
Exterior windows	446 m ²	120/m ²	53,520
Interior windows	500 m ²	120/m ²	60,000
Doors	50 drs	150/dr	7,500
Arcade ramp	240 m ²	250/m ²	60,000
Elevators	4	20,000 ea	80,000
Stairs/ramps	18 flights	3,000/fl	54,000
North balcony	1 allow	5,000	<u>5,000</u>
			320,020
Contingency	15%	320,020	48,000
Management	20%	320,020	<u>64,000</u>
SUBTOTAL			<u>£432,020</u>
GRAND TOTAL FOR SHELL			£4,979,380

construction of a house. It can very often happen, during early planning stages, that certain items within the house begin to go over cost: the client wants expensive built-ins, for example, or beautiful windows. Since such items cannot be contained within the budget which has been set for them, the proposal may often be made, even at that early stage: "let's have the beautiful windows, sacrifice the exterior work—and we'll build that later," (typically the client speaking).

We almost always resist this suggestion. If the building is built without the all-important exterior space, it will be damaged materially. We typically therefore insist that the reduction be made in a cost category which is more closely related to the items which are running over—roof material perhaps, interior finishes, bathroom fixtures, or something else which can be sacrificed. But of course *something* really has to be sacrificed. To pay for one item, another has to disappear or be reduced. That means, very early on, the client begins to appreciate that, to pay for some luxurious item, other items must be rough. Great buildings always have some luxury, and some roughness. The money must be distributed so that some areas are intensified, receive a little more care, are made more beautiful. As a result, less money will be spent on other areas. But this is not a bad thing. It is a good thing because—as in the Alhambra¹⁶—the reduced areas provide a necessary counterpoint to

the intense areas, allowing them to shine.

This fact too, must be faced squarely, in the cost-cutting measures that are taken. And they must be taken, without sacrificing the values inherent in the cost allocation picture *as a whole*. What is vital, at every stage, is that the importance of one item is not allowed to upset the building as a whole, by damaging some other item which is essential to the feeling of the building as a whole. At all events, we try to keep the overall balance intact.

Let us consider an example, previously mentioned, from the early design stage of the Mary Rose Museum, with respect to the foundation. Our cost allocation for this item was £548,000 (\$932,000). The best estimate for this work after months of work was £800,000, down from an earlier estimate of over £1 million. If we had stopped at this point and decided that we had done well enough, we would have had to take £252,000 (\$428,000) from some other item. Instinct told us that the great arches themselves were threatened. If we allowed the foundation to cost £800,000 (\$1.36 million), then the arches and the beauty of the structure would have been threatened, possibly lost altogether. It was therefore vital for the good of the building as a whole, that we could leave the other structural items in the cost allocation intact. This meant the foundation problem *had* to be solved: in other words, we *had* to find a structurally acceptable founda-

tion for the £548,000, and not a penny more. The way in which this was finally accomplished is described under the foundation section.¹⁷ But what is essential here is to show the attitude which goes with the cost allocation method. It is an attitude which focusses attention, at every stage, on the beauty of the building as a whole, and keeps every decision moving in the direction mandated by that concern for balance.

The same thing happens, of course, during the construction phase itself. As construction moves forward, some items cost less than expected, others cost more than expected. Once again, we do not allow items in the "more than expected" category to produce a cost overrun. Instead measures are taken, dynamically, during the construction process. Either quantities are reduced—if that is feasible, to make up for the overrun—or items are reduced, simplified, in other areas of the building—always with an eye to preserving the feeling of the building as a whole, and its essential character. This guarantees cost, in a form rarely accomplished by contemporary architecture.

But it requires a great deal of creative energy. The allocation and redistribution is a creative process, which demands time, skill, and effort, from the construction manager on site and from the architect. These are not details to be "left to the contractor." They are issues which require the full design experience of the engineers and architects

16 Granada, 14th century. In Moorish Spain the idea of a proper balance of rough and smooth was commonplace.

17 See pages 53–55.

who made the design initially. And this is why, in the CES management process, the same team of designers and managers are involved, from the beginning of the design work to the end of construction.

In the CES method, the use of money is a creative act, on par with the architect's sketching, and it has the result that if any one item were to change in cost, the results would ripple throughout the entire project, forcing changes in other items. To a trained person the cost allocation sheets, almost never more than a couple of pages long, completely describe the building in many ways more completely than the design drawings. The allocations tell you where the money is being spent, what the special items are, and where the building will have a "rougher" character. For these reasons, designing the building so that every item meets its cost allocation amount is taken as a deadly serious matter, and much of the design work is directed towards that end.

CRAFTSMEN AND SUBCONTRACTORS

The heart of the process by which we intend to build this building relies on a form of management, and a form of contract, in which decisions are being made directly, by the design and architectural and building team, throughout construction.

In this process, it is our intention to work directly with the subcontractors. In present British practice the word "subcontractor" has often come to mean just another giant construction company. Indeed, when we first spoke with our colleagues in

Portsmouth about this project, we heard to our astonishment that a British norm for a £10 million construction project like this one would be to have no more than four or five subcontractors.

We made it clear, very quickly, to our Portsmouth colleagues that something entirely different would be needed, and that we have a tradition of working in detail, very closely, with the actual men and women who are doing the work. Our guess is that on this job, we would have some fifty subcontractors.

Our own managers, experienced in this type of work, will run the individual craftspeople directly. We will have a group doing concrete, a group doing stone, a group doing brickwork, craftspeople making and setting tile, individual subs doing ironwork, individuals doing rough carpentry, another group doing cabinetwork, others doing plaster.

In all of this, it is the individual plasterers, bricklayers, formwork-carpenters, who make the difference. And the way the operation is run requires that the details of their work can be planned flexibly, and that changes and subtleties are being worked out continuously, between our team of managers and the craftspeople, while the work is going on.

It is only this approach which allows the building to take on the character it *has* to have if it is to have true life as a building. One simply cannot predict, accurately, what it will take to make the building harmonious, when everything has to be thought out in advance. The detail of a railing, the exact position of the windows, the subdivision of these windows,

the shape of column capitals, the pattern of floor work, the exact height of low walls and balustrades, the precise width and position of a doorway, the source and intensity of light, the color and finish of an interior wall, the amount of extra detail in the entrance of the building, the amount of shade and sunshine — these are the details which ultimately govern the harmony and depth of the building. They can only come from careful, day-by-day examination of these details while they are being built, in place, together with the actual individuals who are doing the work.

It is for this reason that we always work directly with our subcontractors and craftspeople, and it is for this reason that we have them working for *us* — not for a mechanized, computerized general contractor that stands in between.

TECHNIQUES OF CONSTRUCTION

Just as new forms of management are needed to produce life in a building, so these must be complemented by new forms of construction technique that are suited to the creation of the forms. To make the construction process well adapted to the beauty of the building, to keep the work on budget and to build structures that have a "reality" to them — that is, structures built of real materials and in configurations which make sense of the materials — it is necessary to be inventive in the detailed specifications of construction sequence and methods.

This concern is different from concerns about contract management — but deeply related, because it also affects se-



Dining hall trusses of similar construction, San Jose, California, 1989

quence and process in ways that have to do with *feeling*. This is vastly different from today's widespread interest in construction processes invented purely for efficiency.

As an example, consider the erection and fabrication of the Museum's arches. When we first began thinking about the concrete lacework arches, we intended to build them by shooting them with gunite (high-strength, dry sand concrete shot under pressure). Other arches built by this method are illustrated on this page, where we show a series of a similar, but smaller lacework arches recently built for a public building in California. In this building the lightweight forms, and steel, were suspended in mid-air in the position they were going to occupy, and the gunite

was then shot directly into the forms.

After careful thought about staging of construction for the Museum and about the finish on the arches, we decided that different methods of construction would work better for the Museum arches. We show the gunite arches, however, to make it clear that even the highly intricate geometrical structures of the Museum arches can be built, with little extra cost, provided that construction conditions and construction methods are solved with inventiveness.

For the Mary Rose Museum, our gunite technique has two disadvantages. First, the complex operation over the dock might endanger the ship, and might also be potentially dangerous for the gunite crews. Second, the surface of the shot

concrete, even when "struck off," would be rough, and might not easily meet the demands for a smooth, nonporous surface required for easy cleaning.

We have therefore devised a different erection procedure, in which the arches are to be cast on the ground as cast-stone or cast concrete in three sections, and then raised into position from travelling cranes running on rails along the two sides of the dock.

This technique has been studied thoroughly at the first level of detail, and has been estimated to our predicted figure of £550,000 (\$935,000) for eleven arches by a British subcontractor.

Other parts of the building will need equally inventive approaches to construction and fabrication. Each technique

must allow its material to be formed and worked to produce feeling and substance in the building, without unusual cost.

SAMPLE CONSTRUCTION CONTRACTS

The following contracts are printed here because they are meant to suggest, to indicate, an entirely different attitude to the task of construction; and to suggest that this new attitude is not

merely something to dream about. It is a practical matter, which, by appropriate practical devices, including new forms of contract, *can* be brought about.

Although some of the people involved in planning the Museum found the concept of the new contracting arrangements difficult and perhaps a little alien, we were gratified that the top managers at Bovis and PSA-BMSE, when they studied our proposals, took them very seriously and immediately rec-

ognized the vast shift in idea and process which these contracts signify.

We hope that the Mary Rose Museum will be able to embody the new spirit in architecture, by making use of these construction management techniques and contracts, and that the promise of a new architecture will be made real, exactly by technical and administrative devices such as these.

CONSTRUCTION MANAGEMENT CONTRACT¹⁸

This contract is made on this _____ day of _____, between _____ (hereinafter called Owner), and the Center for Environmental Structure (CES or Construction Manager and General Contractor of record), for the purpose of building the _____ at _____ location, according to plans prepared by the Center for Environmental Structure.

ARTICLE 1. DEFINITION OF PROJECT

The work is shown on the drawings that are attached to this contract as appendix 1, and specified by the 23 construction operations attached to this contract as subcontract proposals in appendix 2.

The following aspects of the work will be built as specified in the drawings:

- a. Siting of the building(s) as shown on the site plan.*
- b. Configurations and dimensions of building(s) and rooms as shown on floor plan sheets.*
- c. Additional interior and exterior work determined by CES during construction.*

It is understood that the drawings have been obtained for building permit purposes, and are not to be construed as binding architectural plans and specs.

ARTICLE 2. BASE PRICE

Signed subcontract proposals attached in appendix 2 spell out the relative specifications and costs.

Based on these documents, the base price of the building(s) will be \$_____, plus whatever changes shall be agreed to by the Owner in writing.

ARTICLE 3. CES RESPONSIBILITY

CES shall provide management services and supervision necessary to execute and complete construction of the project.

CES will, as construction manager,

- 1. Enter into binding subcontracts with subcontractors.*
- 2. Organize and manage the subcontractors.*
- 3. Make changes to the design.*
- 4. Determine how to spend the available budget so as to most benefit the building(s).*
- 5. Administer construction work so as to meet our understanding of applicable codes.*
- 6. Inspect finished work.*
- 7. Obtain lien releases from subcontractors in exchange for final payment.*
- 8. Keep full and detailed accounts as may be necessary for the construction of the project on behalf of the Owner, and will make those records available to the Owner at any time.*
- 9. At completion, shall provide to the Owner a copy of the marked up job-site drawings, for the Owner's use and records.*

In all matters of subcontractor dealings, in all matters of design changes, and in all matters of money management, the Owner grants CES complete authority to exercise its judgment on behalf of the Owner.

ARTICLE 4. CES GENERAL PHILOSOPHY

It is believed that the approach to construction laid out in this contract and based on the fundamental assumptions above will secure for the Owner the highest quality building(s) possible within the available budget.

¹⁸ This general management contract and the following subcontract were developed from 1983 to 1994 by Christopher Alexander, Gary Black, and James Maguire of CES, and the authors gratefully acknowledge James Maguire's contribution to this work.

ACHIEVING A GREAT BUILDING

Specifically, this approach is designed to eliminate the profit motive of the general contractor. By setting a fixed fee for the management of the job and maintaining open records of all transactions, the typical overbidding by the contractor to protect himself from unforeseen overruns and contractor's markups on materials and subcontracted work are eliminated. In the typical owner-contractor arrangement the overbid money becomes windfall for the contractor and does not benefit the building(s) or the owner. In the model laid out in this contract all available money is spent for the betterment of the building(s).

This method also provides the framework for efficiently dealing with changes which are a fundamental part of making a good building. In the typical Owner-Contractor agreement any changes are discouraged by adding an exorbitant surcharge to the direct costs of the changes, effectively providing the contractor a windfall profit. Even changes which reduce the costs are typically charged as extras. In the method laid out here changes are not subject to additional surcharges and are charged at their actual costs.

CES encourages the Owner to review all subcontracts, and to propose alternative lower-priced subcontractors. CES will evaluate the subcontractor proposals and award subcontracts if CES determines that it is in the best interest of the project, and provided that these proposals are consistent with the construction schedule.

ARTICLE 5. SUMMARY OF CONSTRUCTION OPERATIONS

The construction will be organized under the following construction operations, with the following sums allocated to them. Detailed breakdown, showing subcontract amount, 15% contingency, and CES management fee is given in appendix 3.

1. GENERAL CONDITIONS	_____	13. PLUMBING	_____
2. FOUNDATIONS	_____	14. ELECTRICAL	_____
3. FRAME	_____	15. HVAC	_____
4. FLOOR STRUCTURE	_____	16. ROADS AND PARKING	_____
5. ROOF STRUCTURE	_____	17. CIVIL WORKS	_____
6. EXTERIOR WALLS	_____	18. INTERIOR FINISH WORK	_____
7. INTERIOR WALLS	_____	19. CABINETWORK AND FURNISHINGS	_____
8. ROOFING	_____	20. PAINTWORK	_____
9. MISC. METAL	_____	21. GARDENS AND LANDSCAPE	_____
10. WINDOWS/DOORS	_____	22. OWNER'S REQUESTS	_____
11. BRICK AND TILE	_____	23. BIDDING FEE	_____
12. PLASTERWORK	_____		
		TOTAL BUDGET	_____

The total dollar amount under subcontractor's subcontract proposals and the total dollar amount under contingency will be used by CES to build the building(s). The use of this money is under the sole discretion of CES acting as the manager for the Owner, and may be applied to cost overruns or for any items required by CES to improve or upgrade the building(s).

ARTICLE 6. MANAGEMENT FEE

The Management Fees will be paid directly to CES as outlined under Article 9. The management fees will be used by CES to manage the project and will pay for CES management labor and overheads.

The total management fee paid to CES is \$_____ plus 20% of construction for all construction above \$_____.

The portion of this fee paid to CES for managing the construction of the project as outlined in this contract will be \$_____ plus 16% of construction for all construction above \$_____. This sum will be paid to CES according to the arrangement described in article 9.

The remaining portion of the fee (\$_____ plus 4% of construction for all construction above \$_____) will be paid to CES to cover bidding, organization of subcontractors and setup: \$_____ to be paid as a lump sum, on notification by CES that the bidding work has begun; the remaining \$_____ plus 4% to be paid on completion of the setup work.

ARTICLE 7. ALLOWANCES

Allowances are included in the main contract and subcontract documents for certain items not specified in detail. This portion of the budget is to be used by the Owner. The Owner can spend up to the allowance amount. If the Owner spends less than the allowance amount, the Owner will have the option of applying the savings to other allowance items. If the Owner wishes to spend more than the allowance amount, then they must spend less on subsequent allowance items or supply additional funds.

ARTICLE 8. CONTINGENCY

To protect the Owner and the job against unforeseeable fluctuations of price, unforeseen site conditions, and other changes, each of the budgeted amounts in article 5 contains a contingency of 15%. The contingency money is to be used entirely at CES discretion, for the benefit of the building(s) as judged by CES. CES shall have the right to distribute and redistribute this contingency money as it sees fit, in order to meet difficulties and changes which arise in the building(s), and whenever possible, to make improvements and extras which CES believes will increase the harmony of the emerging building(s).

CES's intention is to maintain as much of the 15% contingency money as possible, and use this money to pay craftsmen who will make various finishing touches continuously throughout the job.

ARTICLE 9. PAYMENT PROCEDURE

The Owner will open a project checking account and make deposits to the account according to the schedule below. CES will be signatory on this account, and will have control of the project checkbook.

The basis for payment will be the list of Construction Operations. Summary in article 5 and detail in appendix 3.

The Owner will make deposits to the project checking account according to the following schedule for each operation:

50% of the price of the operation will be deposited to the account upon notification of the commencement of that operation.

35% of the price of the operation, on demand, when a reasonable portion of the work is completed.

10% of the price of the operation when notified by CES that the operation is at least 85% complete.

The remaining 5% will be paid according to the provisions of article 14.

As each check is deposited to the account, CES will withdraw the appropriate amount from the management category (as shown in appendix 3) to make payment for construction management fees, up to 95% of the total management fee. The remaining 5% of the total management fee will be deposited to CES upon final completion.

All records from the project account and all invoices for materials and labor, and all subcontractor's billings will be available for the Owner's review.

ARTICLE 10. SUBCONTRACTORS

Subcontract proposals for items 2–21 are attached as appendix 2. These proposals, signed by the various subcontractors constitute an addendum to the general contract, and serve as the basis for the project specifications and the construction budget. At the appropriate time CES will obtain subcontract proposals from subcontractors for any remaining items.

In performance of this task, CES will seek out and hire subcontractors which in CES's opinion are most appropriate for the particular job. The criteria may be price in one instance, timeliness in another, and quality of work in another. CES is under no obligation to find the "lowest" subcontractor, nor the "best" subcontractor.

Should a subcontractor default on their subcontract, for any reason, CES will endeavor to renegotiate or find another subcontractor to perform the work. CES will proceed in a manner which it determines is in the best interests of the Owner and the project with respect to time, quality, flexibility, and price, but CES is under no obligation to provide subcontracts or subcontractors at a guaranteed price.

The relationship between CES and the subcontractors shall be a contractor-subcontractor relationship. Within the confines of such a relationship, CES will include its best efforts to provide appropriate guidance of the subcontractors in the performance of their work. CES is to be sole agent on behalf of the Owner. The Owner or any agents of the Owner aside from CES, are explicitly forbidden from giving any directions to, or making any requests directly to any of the subcontractors. The Owner may, of course, make requests through CES as provided in article 11.

ARTICLE 11. DESIGN DECISIONS AND CHANGES INITIATED BY CES

Part of CES philosophy is that there are no defined plans and specifications. CES will have authority to make design decisions and design changes as it determines necessary, without written confirmation from the Owner, as long as these decisions do not increase the total budgeted cost. Whenever possible CES will confer with the Owner but CES is not obligated to do so. Design decisions and changes may be generated by any of the following causes.

CES-initiated design changes may be generated in response to the emerging building(s). As the building(s) and rooms begin to take shape, doorway sizes and locations, window sizes and locations, wall locations and wall lengths, cabinets, finishes, etc. may have to be altered. These decisions can only be made on the site, during construction, as the building(s) is taking shape.

CES-initiated design changes will be required to keep the overall price of the building(s) in budget. As a result of some unforeseeable problem, or as a result of an overage due to a previous design change, it will become necessary to make changes in the building(s) to offset the overages. This is not something that might happen, it is something that will happen. Although often seen as negative, these types of changes are more often than not positive changes which ultimately result in producing the best buildings.

CES will confer with the Owner in major design decisions which the Owner has identified as important ahead of time, and before making any major design changes, but CES has the main commitment to "listen" to the emerging building(s), and to do what is in the best interests of the building(s). The Owner will be consulted on and encouraged to participate in the detailed layout of _____ as the Owner has requested.

ARTICLE 12. CHANGES NOT COVERED BY ARTICLE 11.

Changes not covered by article 11, and resulting in an increase of cost, will be approved in writing by the Owner. In cases where an increase of cost is anticipated, the Owner must approve the change in writing before CES can begin the work. If the Owner does not approve it, the work will not be done.

ARTICLE 13. TIME

The work to be performed under this contract shall commence within 15 days of the signing of this contract. The work shall be completed in accordance with the schedule provided pursuant to the paragraph below.

Both Owner and CES desire to complete the project in _____ months starting from the date of commencement. CES will provide the Owner with an estimated construction schedule for the project. This schedule shall indicate the dates for the starting and completion of the various stages of the construction and shall contain the necessary information to allow the Owner to monitor the progress of the work. It shall be revised as required by the conditions of the work and those conditions and events which are beyond the control of CES.

The Owner agrees that if the building process is slowed down, by any act or neglect of Owner, by any separate contractor employed by the Owner, by any unreasonably slow process of decision making or design negotiation from the Owner, CES will then be entitled to an appropriate increase of management fee, to make up for the extra time. If the building process is slowed down for any other reason not caused by CES negligence, CES and the Owner will negotiate fair compensation if any additional management fee is required. Adherence to time conditions is of vital importance to the proper running of the job site, and is of material importance to the successful completion of this contract.

ARTICLE 14. SUBSTANTIAL COMPLETION

The date of substantial completion of the project or a designated portion thereof is the date when construction is sufficiently complete in accordance with the drawings and specifications so the Owner can occupy or utilize or, in fact, does occupy or utilize, the project or designated portion thereof for the use for which it is intended.

The date of substantial completion shall be established in writing, signed by the Owner and CES. At that time, a punch list of items to be completed or corrected (if any) shall be prepared by the Owner and CES along with a time schedule for their completion or correction, and the remaining unpaid balance of the contract including the 5% subcontract retentions will be deposited to the construction account.

ACHIEVING A GREAT BUILDING

ARTICLE 15. LIEN RELEASES

CES warrants that all money paid by Owner, except management, will be used on the building to pay for materials, job expenses, subcontractors and craftsmen.

CES will obtain partial waivers of lien for all payments to subcontractors and will forward these to the Owner.

ARTICLE 16. FINAL PAYMENT

Following full completion of the work as defined by the punch list (article 14) and final inspection and acceptance of the work in writing by the Owner, CES shall have authority to make final payments to subcontractors, and to withdraw final payment of the management fee. To protect the Owner CES agrees that they will not use these funds to make final payments until the subcontractor has provided the appropriate final lien releases. When all payments have been made, CES will issue a duly executed final waiver of lien.

ARTICLE 17. CES OBLIGATION AND FIRST-YEAR REPAIRS

CES will maintain \$_____ from the contingency in the job account, for a period of one year after final completion. This money is to be spent for repairs and annoyance items which occur after final completion. CES will use the \$_____ at its discretion, to fix items that are unsatisfactory to the Owner. If, one year after final completion, this money or any part of it remains unspent, CES will use the balance in consultation with the Owner, to make some nice small improvements to the building(s). CES shall have no further obligation, beyond that covered by this money, for making repairs or improvements on items considered unsatisfactory by the Owner. CES will also make its best efforts to help the Owner enforce the warranties provided by subcontractors.

ARTICLE 18. JOB EXPENSES

Owner will maintain working telephones on site at all times. Owner will supply working electric service and water to the job site. Owner will supply toilet, storage, cleanup facilities and lunch room for subcontractors workers at all times. Owner will reimburse CES management personnel for mileage to and from CES office, at 27 cents per mile. CES will pay the phone, electric, water and toilet bills, together with mileage reimbursements out of the job account. Estimated costs for these items are included in the construction budget under general conditions. If these costs run above estimate, overage is to be carried by Owner.

ARTICLE 19. UNKNOWN CONDITIONS

The work may include modification or connection to existing structures. It is not possible to anticipate all problems which may arise, in the work of connecting to such existing structures. If unexpected conditions that affect the performance of the work and vary from those indicated by the contract documents, are encountered, base price of project and schedule shall be equitably adjusted for such unexpected conditions in writing between CES and the Owner upon claim made by CES.

ARTICLE 20. INSURANCE

The Owner will carry all necessary general liability, fire, and earthquake insurance and any other insurance which may be required to protect the Owner against claims which may arise from operations under this project.

CES will purchase and maintain the following insurance to cover CES's operations under this agreement:

- 1. Worker's compensation insurance in full compliance with worker's compensation laws of the State of California for all employees of CES and other persons directly associated with CES's management team.*
- 2. CES will, in addition, request that all subcontractors provide certificates of worker's compensation insurance for their employees. In any case where this is unavailable, CES will carry the necessary worker's compensation on its own policy and deduct the cost from the subcontract price.*

ARTICLE 21. CES SPECIAL CONSTRUCTION METHODS AND PHILOSOPHY

The Owner recognizes that the methods and philosophy of CES include unusual use of materials, and unusual combinations of high-level and low-level finish. The building(s) will not necessarily be designed to typical California industry standards for residential or public buildings, and the Owner's desire to break with these prevailing standards is explicitly part of the intent of this contract.

Owner approves the form and content of the CES subcontract forms attached to this contract as appendix 2, and recognizes the right of CES to make substitutions as provided in the subcontract agreements.

The Owner is specifically bargaining for CES's exercise of its independent judgment in carrying out the above-described construction methods and philosophy.

ARTICLE 22. SAFETY

CES shall take necessary precautions for the safety of CES employees on the job, and shall comply with all applicable provisions of federal, state and municipal safety laws. CES shall have no responsibility for the abatement of safety hazards resulting from work at the job site carried on by other persons, or by subcontractors. Subcontractors will be responsible for their own safety, but CES and CES employees will encourage safety on the site.

ARTICLE 23. WARRANTIES

CES warrants to the Owner that all materials and equipment furnished under this agreement will be new unless otherwise specified, and that all construction work will be of good quality, free from improper workmanship and defective materials. Any warranty or guarantee obtained by CES from any manufacturer, shall be deemed to have been obtained for the benefit of the Owner. CES will collect all equipment manuals and deliver them to the Owner together with all written warranties from equipment manufacturers, and CES will have no further obligation with respect to them.

ARTICLE 24. ATTACHMENTS

The signed subcontracts and documents attached hereto as appendices are expressly incorporated into this contract. To the extent the attachments are inconsistent with the main contract, the terms of the main contract shall govern.

THE MARY ROSE MUSEUM

ARTICLE 25. ARBITRATION

Claims, disputes and other matters in question between the parties to this agreement arising out of or relating to the agreement shall be decided by arbitration in accordance with the construction industry arbitration rules of the American Arbitration Association then in effect, unless the parties agree otherwise. This provision shall be specifically enforceable in any court of competent jurisdiction.

Notice of demand for arbitration shall be filed in writing with the other party to this agreement and with the American Arbitration Association. The demand shall be made within a reasonable time after the claim, dispute or other matter in question has arisen. In no event shall the demand for arbitration be made after the date when the applicable statute of limitations would bar institution of a legal or equitable proceeding based on such claim, dispute or other matter in question.

The award rendered by arbitrators shall be final, and judgment may be entered upon it in accordance with applicable law in any court having jurisdiction.

Unless otherwise agreed in writing, CES shall carry on the work and maintain its progress during any arbitration proceedings, and the Owner shall continue to make payments to CES in accordance with the contract documents.

This article shall survive completion or termination of this agreement.

ARTICLE 26. ATTORNEYS' FEES

In the event that either party files suit to enforce the provisions of this contract, the prevailing party shall be entitled to a reasonable attorney's fee as cost of suit, to be fixed by the Court.

Signed

_____ date _____ for CES _____ date
for the Owner

CRAFTSMAN/SUBCONTRACTOR AGREEMENT

This agreement seeks to obtain the best possible work for the owner by obtaining design and construction input from the craftsman, encouraging an old-world attitude of quality towards the work, and by giving flexibility of on-site design decisions to CES. This agreement is made on this _____ day of _____, 19____, between The Center for Environmental Structure (hereinafter CES) and the craftsman defined below (hereinafter craftsman). All subcontractors are referred to as craftsman, even when a company or organization is providing service, and even in the case of heavy engineering works, in order to emphasize the craft-like nature of the work which CES expects.

CRAFTSMAN/SUBCONTRACTOR

JOB DESCRIPTION

For details of job description see page 3 of this contract.

PRICE _____

PART 1
GENERAL CONDITIONS

ARTICLE 1. PURPOSE

The purpose of the work is to build a building under conditions which allow craft, care, love of the building(s), love of work, and the life of the emerging building(s), to be created to the maximum extent possible. The nature of this subcontract is designed to make this possible, while protecting the interests of owner, manager and craftsman.

ARTICLE 2. DEFINITION OF THE WORK

The craftsman will perform the work defined in the job description attached to this contract, and signed and dated by the parties. It is agreed that this work is defined and modified by the conditions of part 2, articles 7-11.

ARTICLE 3. PRICE AND PAYMENT SCHEDULE

For performing the work specified in article 2, the craftsman will be paid a total price of \$_____.
The first 80% of the price will be paid to the craftsman in progress payments based on percentage of work completed, as approved by CES. 15% of the price will be paid to the craftsman after completion of the craftsman's work, and after written declaration by CES that the work is satisfactory and complete.
The final 5% of the price will be paid to the craftsman after final completion of the construction contract, and after sign-off of the punch list by the owner.

ACHIEVING A GREAT BUILDING

ARTICLE 4. CRAFTSMAN RESPONSIBILITIES

The craftsman is responsible for:

- 1) *Insuring compliance with applicable codes.*
- 2) *Adhering unequivocally to the price set forth in this contract.*
- 3) *Following good construction practice.*
- 4) *Either 4a or 4b. One must be checked.*
 - 4a) *Providing affidavits of worker's compensation insurance. —*
 - 4b) *Making provision to be carried on CES's worker's compensation insurance. —*
- 5) *Providing the owner with a completed package as set forth in article 5.*
- 6) *All penetration of building components shall be neat, sleeved, and fire-stopped and shall not compromise structural integrity or water-tightness of the structure.*
- 7) *Craftsman will clean up all dirt, blemishes and trash generated by his job, and haul away, leaving the site clean of his work.*
- 8) *Craftsman will come back to repair or modify any items not adequately completed, at the direction of CES when final punch list is made between CES and owner.*

ARTICLE 5. CRAFTSMAN'S GOAL

The ultimate purpose of this agreement is to secure the craftsman's work under conditions which make the craftsman's work a work of beauty and pride and self-respect, and in which the craftsman leaves behind work he is proud of, and can cherish in the future.

It is specifically understood that the craftsman's goal is not only to be paid for his work, but that the beauty and satisfaction of the work itself provide part of the craftsman's reward. To this end, the craftsman shall be treated as an artist who has some power and control over his work as necessary to allow the creation of a beautiful and fitting work within limits accepted by CES.

ARTICLE 6. GUARANTEE

Craftsman warrants his work for a period of _____ and will repair or replace any item found defective within the warranty period.

PART 2

RULES GOVERNING EVOLUTION OF THE WORK

ARTICLE 7. BASIC RULE

The essential agreement governing this contract, is that the price remains fixed, and that changes made by CES or by the craftsman, are always made while keeping the price fixed.

ARTICLE 8. CRAFTSMAN'S OWN TIME FOR BEAUTIFUL EXTRAS

It is explicitly present in this agreement that in performance of article 5 (part 1), the craftsman will spend some time over and beyond the call of duty, to make a few very nice details. The craftsman will choose the time, location and nature of these details, and will do them with the intent to make a good job of the project. These details should be checked with CES manager before performance.

ARTICLE 9. EXTRA LABOR AND MATERIALS ALLOWANCE UNDER CES CONTROL

As part of the performance of this contract the craftsman will provide _____ crew-days of labor and a _____ materials allowance to undertake any extras directed by CES. A crew is _____. These extras are specifically over and above the performance of the base task defined in the job description, and are intended to provide small extras which will make the job better and more beautiful.

ARTICLE 10. SUBSTITUTIONS

CES shall have the right to make substitutions within the basic job description, reducing some portion of the work, to pay for an increase in other portions. Substitutions are to be negotiated with craftsman, and not to increase total price.

ARTICLE 11. FLEXIBILITY DURING CONSTRUCTION

There is an essential base condition to this contract: In order to make the best building(s) possible, it is not always possible to define the work exactly, ahead of time. The use of working drawings as a precise determination of construction responsibility does not allow the proper life to appear in the building(s), and is specifically eschewed by this agreement. The purpose of this agreement is to give CES and the craftsman the necessary flexibility during construction, while protecting the owner in regard to price.

In order to protect the owner from unacceptable cost overruns, the parties have agreed that the work will be done for a fixed budget, and that the owner will have the work specified in this subcontract performed for a definite fixed sum.

In order to protect the craftsman from having to perform more than he can fairly do under the fixed-sum contract, the craftsman has the right to rearrange the work after negotiation with CES. When CES makes requests not covered or anticipated in the job description, and which clearly cost more, CES and craftsman will then negotiate to reduce work or material or labor in one portion of the subcontract, to make up for the new needs. The owner accepts this arrangement as the necessary consequence of a more flexible approach to building, and a fixed-price contract. It means that some items may be built to a reduced specification or not built at all.

The essential purpose of this contract, is to produce a fair and balanced solution of this base condition, in a way which is fair to all parties. It must be emphasized that all parties, CES, owner and subcontractor, have an interest in making sure that this condition is fairly met. The parties agree to this condition and accept it as essential to all performance of the work.

PART 3

SPECIAL CONDITIONS

ARTICLE 12. SCHEDULE

CES will give craftsman 15 days notice prior to start of job, and craftsman will commence work on the specified day. Work is to be completed within _____ days thereafter.

ARTICLE 13. LIEN RELEASES

Craftsman will sign a partial lien release executed with each progress payment.

ARTICLE 14. CHANGES REQUESTED BY CES WHICH REQUIRE ADDITIONAL COMPENSATION

This contract, as written, only covers those items of work defined in the signed job description, or explicitly dealt with under the items of flexibility section (article 5). Items of extra work outside the range of flexibility, which arise as a result of requests made by CES, shall be negotiated and charged separately to the owner.

ARTICLE 15. UNANTICIPATED WORK CAUSED BY UNANTICIPATED CONDITIONS OR OWNER'S REQUESTS

Extra work which arises during performance of the job, whether as a result of unforeseen job conditions or as a result of requests made by the owner, shall be negotiated and charged separately to the owner.

ARTICLE 16. COORDINATION WITH CES REPRESENTATIVE

Craftsman is directly responsible to CES representative only, and may not act upon requests made by the owner, unless these are channeled through CES.

Signed

Craftsman/Subcontractor _____ date _____ for CES _____ date _____

JOB DESCRIPTION

The description below gives our current understanding of the particulars for the _____ job for the _____ building(s).

On top of base job, job price must also include _____ crew-days of labor under CES control, for architectural extras to be defined by CES.

TIMING

Work to be done between _____.

SUBCONTRACT PROPOSAL REQUEST

The enclosed documents show our current understanding of the _____ job for the _____ building(s). The maximum amount allocated for this item is \$ _____. It is imperative that you make a proposal which is less than or equal to this amount. If you cannot meet this budget or better it, you may propose a reduction of scope or change of specifications. Please submit a detailed proposal for this job on page 3 of our enclosed subcontract forms. We shall award this contract to the subcontractor who defines the most attractive proposal. We strongly recommend that you discuss with us, and negotiate in detail, the nature of your proposal, before making your written submission.

COMPLETENESS OF PROPOSAL

This list may not be complete. It is the craftsman's responsibility to study the _____ job in detail, and to include in his proposal everything necessary to do a complete job.

PSA-BMSE¹⁹/BOVIS²⁰
ANALYSIS OF CES
MANAGEMENT
TECHNIQUES

At the suggestion of the Prince of Wales, in early 1992, we asked PSA-BMSE in Portsmouth, in conjunction with their contractor-manager Bovis, the

British construction consortium, to make an assessment of the Museum's feasibility—both with regard to engineering and construction techniques, and with regard to the all-important question of construction management as it has been described in the foregoing pages. We sought advice in particular, as to the British firm's

assessment of the suitability of CES management techniques for British conditions, and of the possibility of adapting these techniques to the construction of the Mary Rose Museum. These questions were asked in the context of an overall request to PSA and Bovis to join with us in building the Mary Rose Museum, and

19 PSA (Property Services Agency) and its southeast division PSA-BMSE (Building Management South-East) provided us with numerous engineering and management consulting services. John Hewitt, chief engineer of the Portsmouth office, in particular provided a wealth of information and enthusiastic support.
20 Bovis, the construction consortium, was at the time of this work helping to reorganize PSA. In their capacity as contractor manager for PSA, and in view of their vast experience with different forms of construction management, Bovis provided support to the studies which are reported below.

the answers reflect the conviction of these two organizations in their readiness to stand behind the building design, its cost, and the novel management techniques which we proposed to introduce.

The preliminary report, issued by PSA-BMSE and Bovis for CES and for the Prince of Wales, and submitted to Mary Rose Trust in January 1992, concluded with the following lengthy statement:

The CES approach to building design and procurement is fundamentally different, whilst at the same time embodies many aspects of construction practice adopted in the UK. CES proposes, uniquely, that the architect should assume the role of Prime manager of both design and construction, and to implement this approach by the use of specialized forms of management contract and sub-contract.

We have reviewed the methods advocated by CES in the context of more traditional building procurement strategies, but primarily those which take account of the three principal project constraints:

1. The constraint of time imposed on the project.

2. The essential requirement, in our view, to complete overall investigations and design development before proceeding to the working drawing/construction phase.

3. The need to secure planning approval for a coherent building design. We have mentioned already that we consider it is essential to conclude all fundamental design issues before proceeding to the working drawing/construction phase. This is especially important, in our view, on a project as complex as the Mary Rose Museum. In consequence, we believe that the project strategy should permit adequate pre-construction development time, whilst also incorporating a measure of carefully controlled parallel working, to accommodate the principal constraint imposed by the ship hall completion date.

There are two main approaches to procuring buildings in the UK where speed is of the essence, and some parallel development working is essential:

1. The first, Design and Build, involves an architect in direct contract with a builder, employed by the Client

to deliver the building to time and to cost. Whether the same architect is employed throughout the process, from concept to completion is immaterial, the building design depends on commercial considerations.

For routine buildings such as offices and supermarkets where quality and sensitivity of design are subordinate to other factors, this system can be effective.

We consider however, that such a procurement method is inappropriate to a building as important as the Mary Rose Museum.

2. The second contractual approach may take one of two forms:

Management Contracting, in which the Client enters into separate contracts with a Designer and a Management Contractor. The Management Contractor enters into sub-contracts with Works Contractors.

Construction Management (CM), in which the Client enters into separate contracts with a Designer, a Construction Manager and the Works Contractors.

For a project of the size of the Mary Rose Museum, recent UK research suggests that employment of a Construction Manager is a preferred form of management given the demands of many Clients for the controls inherent in the familiar framework of traditional contracting.

The CES approach, whilst reflecting Management Contracting methods goes further, and advocates assigning the responsibilities of both Designer and Management Contractor to one person—the architect. By so doing, the technique provides a flexible professional service through the whole design and construction process, which is not normally realized in UK Management Contracting methods.

The specific advantage of this is the direct control of quality by selection of sub-contractors that satisfy the architect's criteria, and the direct involvement in the quality control and supervision process by the design team on site.

Flexibility is guaranteed both in sequence and speed of the various sub-contract operations, and by holding responsibility for construction financing, the architect can decide how money should be spent, or re-allocated, or indeed saved.

In effect the CES approach is similar to Construction Management, but with two important modifications:

1. The architect is not advisory to the Construction Manager, but responsible for the Construction Manager who is on the architect's staff.

2. Management contracts and sub-contracts with Works Contractors are not of a standard UK construction industry form, and are with the Construction Manager and not the Client. In principle, PSA-BMSE believes that a version of the CES approach to Construction Management will be possible on the Mary Rose Museum, and we will be willing to cooperate with this approach under CES direction.

However, we believe that a considerable number of questions remain to be resolved.

Though the process of discussion on these outstanding issues has commenced, we believe that it will require further time, additional to that available for this report, to provide the completed organization and structure in which CES and PSA-BMSE, assisted by Bovis, can co-operate and jointly perform the construction management of the Mary Rose Museum.

CONCLUSION

We have reviewed the technical feasibility of the building carefully, and at first sight the design by CES appears to present many difficult problems. The construction of substantial foundations in proximity to No 3 Dock, the forming and erection process for the main arches, and control of the ship hall environment are the most obvious. During the course of our review it has become quite apparent however, that these problems are amenable to reasonable solution.

PSA-BMSE is of the view therefore, that nothing indicated in CES's preliminary design is impractical, and that the Museum building as currently conceived can be built within available technology and practice.

Considerable design development work remains, which will involve more physical investigation. The technical complexity of the remaining design, together with the sensitive historical setting of the building, suggests that this work should be completed before any form of construction is commenced. It is therefore imperative, in our view, that project development should proceed carefully in a sequential manner.

Our assessment of the CES Prime management methods indicates that the approach is wholly consistent with se-

quential project development, and in many ways complements such a process by pursuing true continuity between design and construction. We can strongly advocate any method which enhances continuity, and from our perspective the CES proposals are singularly aimed at such a target.

There is, without doubt, considerable work to be done outwith the mainstream of project design development. The programme illustration given earlier confines attention to the essential time-table for design and construction. We judge however, that a considerable number of extraneous issues still need to be resolved, not least the time required by the Client to secure financing and approve the project proposals, and to re-initiate the design process. This situation must inevitably cloud what should be a clear positive approach to design development which will, unless the issues are resolved immediately, impede the project and jeopardize the completion date of the ship hall.

We also believe that immediate steps should be taken to establish detailed

working arrangements, and organization for both design and construction.

The preparation of a project execution plan, embracing all factors that influence the project, and reflecting a formal statement of the project objectives and the strategy for their attainment would, we believe, help to crystallize the many issues that remain to be concluded.

PSA-BMSE believes that the form of Prime management advocated by CES has advantages over more traditional methods of building procurement, but represents such a radical departure from traditional practice, that participants will inevitably need to co-operate to realize the ambitions of the methods. These include achieving very high quality, whilst at the same time holding cost and time to plan. In principle, PSA-BMSE believes that such methods will be possible, but recognizes that considerable detail remains to be worked out before the methods can be implemented. The Mary Rose Museum project, we feel, offers no technical impediments to such methods.

PSA-BMSE is confident in both the technical feasibility of the building as designed by CES, and the comprehensive cost plan that reflects the project proposals. So far as is possible at such an early stage of project development, we consider that the cost plan represents, at current UK cost, the building and fitting-out requirements for a Museum; we also consider that it is feasible to contain the current scope of the project within the cost plan budget estimate. The results, reported to us, of preliminary discussions carried out by both CES and the Mary Rose Trust into the question of planning approval for the project are most encouraging. It is clear nonetheless, that considerable consultation work remains on this issue, and we would advocate continued care and diligence in this area.

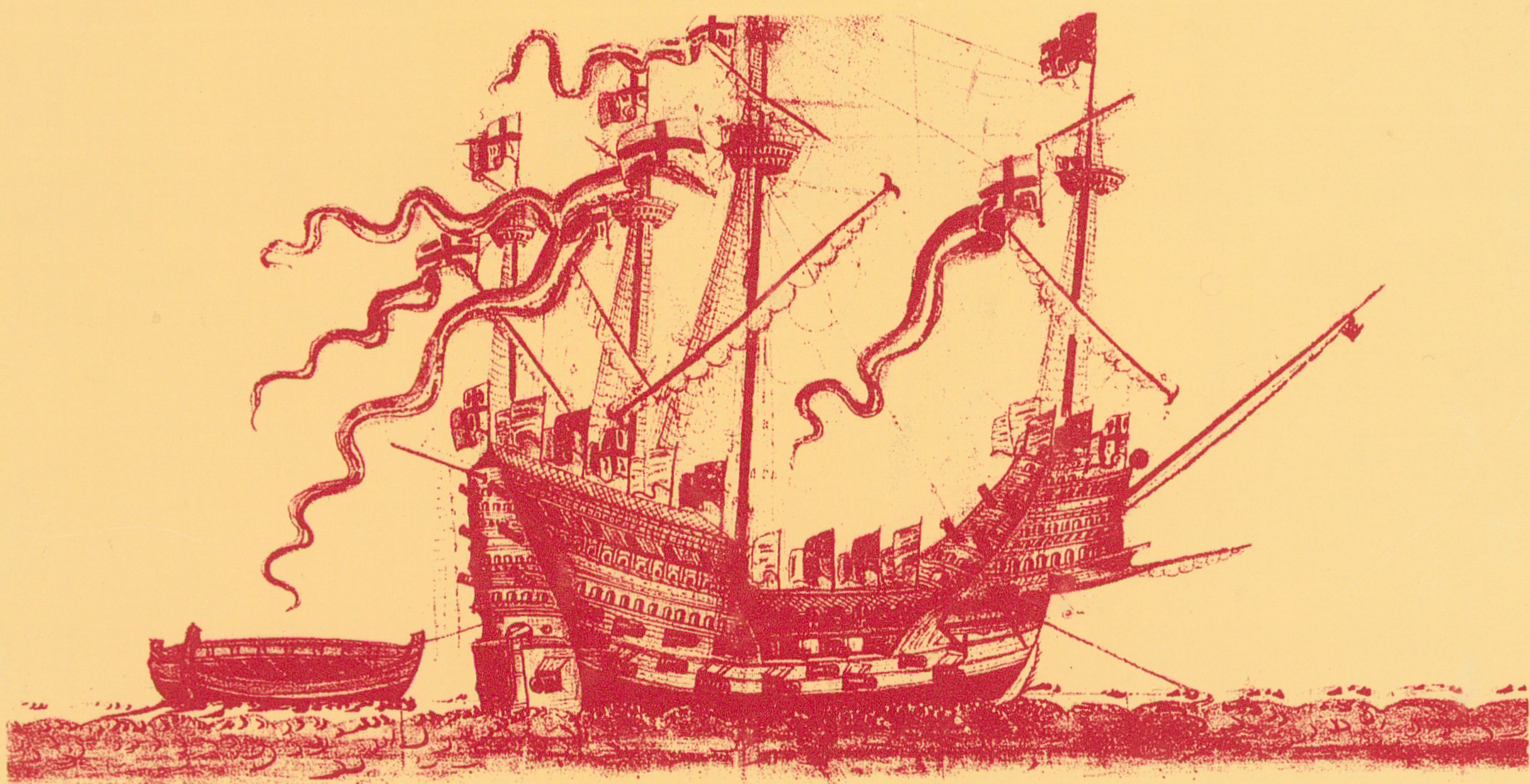
We therefore recommend a careful programme of discussion with the various planning approval bodies involved with the building, and that this deliberate programme should be regenerated immediately.

The conclusion was that these construction management methods, developed in California, can reasonably be translated into British practice to build the Mary Rose Museum.

Careful and sober analysis by BMSE, a division of one of the largest public procurement agencies in the UK — PSA — backed by its contractor manager Bovis, one of the largest private construction management firms in the UK, concluded that the management methods were sound and practical.

To repeat the key findings of the report: “PSA-BMSE is of the view therefore, that nothing indicated in CES’s preliminary design is impractical, and that the Museum building as currently conceived can be built within available technology and practice” and “Our assessment of the CES Prime management methods indicates that the approach is wholly consistent with sequential project development, and in many ways complements such a process by pursuing true continuity between design and construction. We can strongly advocate any method which enhances continuity, and from our perspective the CES proposals are singularly aimed at such a target.”

The Mary Rose Museum



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